### Ampaire and Surf Air Mobility Join Forces for Electric Future of Aviation

by Mr. Kevin Noertker, 18 February, 2021

**Founder, President of Amp Division, Surf Air Mobility, and Co-Founder, Chief Executive Officer (CEO), Ampaire**

Today, Ampaire begins a new chapter. We have entered into a definitive agreement to be acquired by Surf Air Mobility. Together, we’re accelerating adoption of electric flight to substantially reduce the cost and environmental impact of aviation. We’re combining all of the critical components to achieve our shared vision of a future where personalized air travel is affordable for everyone and sustainable for generations to come. See Press Release.

We’ve achieved an incredible amount in our last five years. We’ve become recognized as thought leaders and pioneering ‘doers’ in electrified aviation. Our partners trust us, and our customers are enthusiastic to buy our products. We have flown the largest hybrid-electric aircraft, then flown it farther than any electrified general aviation aircraft, then flown it routinely on an airline route. We’ve been hard at work with NASA, the Department of Energy and private sector partners. We’re innovating every day with new battery cooling technology, new high-voltage components, new charging systems and new powertrain architecture, and more — all aimed at developing practical, trusted and compelling alternatives to today’s aircraft. The next phase of our journey is incredibly exciting.

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**March 2021**

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**First IRBM Intercept – 60 Years Ago**

*by Mike Gruntman, Professor of Astronautics at USC, 3 March, 2021 (with permission)*

https://www.linkedin.com/pulse/first-irbm-intercept-60-years-ago-mike-gruntman

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**IRBM Intercept 1961 – 60 Years**

On March 4, 1961, a Soviet guided missile intercepted and destroyed the approaching warhead of an intermediate-range ballistic missile (IRBM) SS-4 (R-12) at the Saryshagan test site in the Kazakhstan desert. Several successful intercepts followed, paving the way for the emergence of a powerful political, military, scientific–technological, and industrial missile defense complex in the Soviet Union.

A new chapter in the eternal competition between protecting and avenging, between the sword and the shield, has begun. While the U.S. Army demonstrated intercepts of tactical ballistic missiles earlier, the 1961 destruction of an IRBM warhead paved the way to emergence of strategic, or national, missile defense (http://astronauticsnow.com/md/).

This Soviet development culminated in deployment of the operational nuclear-armed missile defense system A-35 in early the 1970s protecting the Russian capital Moscow. Its successor, A-135, is operational today.

The Soviet Union began work on interception of ballistic missiles in the early 1950s. It relied on the prior development of the first guided missile air defense system SA-1. Accomplished scientist in radio engineering Grigorii Kisunko led the effort that achieved the first non-nuclear warhead intercept in 1961. The first intercepts also initiated development of penetration aids to defeat defenses of adversaries.

Missile defense looked impossible to many in mid-1950s. Effective radar cross sections of warheads were 100 times smaller than those of typical aircraft and they flew at velocities up to 20 times faster than contemporary planes. The intercept would last only a few minutes from the warhead detection. Therefore, antimissile missiles had to be launched on short notice in a highly automated, computer-controlled process with precision, speed, and guidance accuracy far beyond the state of the art. At that time, electronics relied almost exclusively on vacuum tubes; digital computing was still in its infancy.

It was a bold decision to proceed with the development, pouring enormous resources into science, industry, and building a huge new test site in a hostile desert area without any infrastructure.

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Missile defenses did not stop rocket attack in Iraq

Can the US defend Its personnel on foreign bases?
by Dr. Stephen Bryen, Former Deputy Under Secretary of Defense, 4 March, 2021 (with Permission)


A US soldier walks past a drone at the Ain al-Asad airbase in the western Iraqi province of Anbar on January 13, 2020. Photo: Ayman Henna / AFP

A t least 10 Katyusha-type rockets slammed into the Ain al-Asad airbase located in Anbar province in Western Iraq on the morning of March 3. Since the earlier attack in January 2020 by heavier Qiam-2 advanced tactical ballistic missiles launched from Iran, the airbase has been reinforced with air defenses that proved unable to stop the rocket attack. Can the US protect its personnel in Iraq or elsewhere from rocket attacks?

The latest available information says that one US contractor was killed and one US service member wounded. Five contractors also were wounded.

Unlike the January attack, this assault originated not far from the airbase in the al-Bayader agricultural area near the town of al-Baghdadi. The rockets were launched from a hidden set of launch tubes on a standard dump truck. The truck was found burned out 8 km (5 miles) from the al-Asad airbase.

The rockets were 122 mm Arash variations made in Iran. (The rockets are named after Arash the Archer, a heroic archer in Persian mythology.) Arash rockets have an 18 kg (about 40 lbs) high explosive warhead. Typical Arash models are not guided but depend on launch angle and are fin-stabilized. However, Iran announced in 2020 it was introducing a guided version. There is no definitive information that the Arash rockets used against al-Asad were guided but there is physical evidence found at the scene of the burned-out truck that indicates the launch group had an internet connection.

It is notable that the rockets hit their mark, suggesting something more was involved than an unguided round. Very often Katyusha-type rockets miss their targets by a significant margin. This suggests that the rockets used to attack the Ain al-Asad base on March 3 may have been equipped with inertial guidance systems, GPS and internet links for control and guidance.

The launch tubes in the dump truck were cleverly hidden under the truck bed. By raising the bed, the truck became a TEL (a transporter, erector, launcher). There is a video of the burning truck in which the launch tubes under the bed are visible.

It is not clear why the truck burned. It could have caught fire when the multiple rocket launches ignited the fuel tank and triggered an explosion. Or the launch team may have set fire to it after the launch disabled the vehicle.

The US is supposed to have two air defense systems at Ain al-Asad: a Patriot missile battery and a C-RAM. There is no information that either system was activated. Even if the C-RAM and Patriot systems did respond to the Katyushas, neither is ideally configured to counter this kind of threat. C-RAM is a gun system and the operator has to detect, aim and fire the gun to hit an incoming missile. Ten rockets arriving in quick succession would most likely overwhelm a C-RAM system even if it had detected the incoming rockets in time. The Patriot system is not designed to hit small artillery-round type rockets. It would seem there is a coverage gap for US forward defenses that was exploited by the enemy.

The Arash is reported to have a speed of 1,610 mph, or Mach 2. Given the distance covered, this works out to an 11-second flight trajectory from launch to target.

Unfortunately in this attack, there was no early warning. When Ain al-Asad was attacked by Qiam-2 missiles in January 2020 there was a warning. The US knew the Iranians had accessed commercial satellites to pinpoint target locations on the base. It is also quite possible that preparation for the launch of the liquid-fueled Qiam-2

(Continued on Page 24)
D-Wave Demonstrates Performance Advantage in Quantum Simulation of Exotic Magnetism

by D-Wave Systems Inc., 18 February, 2021 (with Permission)


D-Wave Systems Inc., the leader in quantum computing systems, software, and services, today published a milestone study in collaboration with scientists at Google, demonstrating a computational performance advantage, increasing with both simulation size and problem hardness, to over 3 million times that of corresponding classical methods. Notably, this work was achieved on a practical application with real-world implications, simulating the topological phenomena behind the 2016 Nobel Prize in Physics. This performance advantage, exhibited in complex quantum simulation of materials, is a meaningful step in the journey toward applications advantage in quantum computing.

The work by scientists at D-Wave and Google also demonstrates that quantum effects can be harnessed to provide a computational advantage in D-Wave processors, at problem scale that requires thousands of qubits. Recent experiments performed on multiple D-Wave processors represent by far the largest quantum simulations carried out by existing quantum computers to date.

The paper, entitled “Scaling advantage over path-integral Monte Carlo in quantum simulation of geometrically frustrated magnets”, was published in the Journal Nature Communications (DOI 10.1038/s41467-021-20901-5, February 18, 2021). D-Wave researchers programmed the D-Wave 2000Q™ system to model a two-dimensional frustrated quantum magnet using artificial spins. The behavior of the magnet was described by the Nobel-prize winning work of theoretical physicists Vadim Berezinskii, J. Michael Kosterlitz and David Thouless. They predicted a new state of matter in the 1970s characterized by nontrivial topological properties. This new research is a continuation of previous breakthrough work published by D-Wave’s team in a 2018 Nature paper entitled “Observation of topological phenomena in a programmable lattice of 1,800 qubits” (Vol. 560, Issue 7719, August 22, 2018). In this latest paper, researchers from D-Wave, alongside contributors from Google, utilize D-Wave’s lower noise processor to achieve superior performance and glean insights into the dynamics of the processor never observed before.

“This work is the clearest evidence yet that quantum effects provide a computational advantage in D-Wave processors,” said Dr. Andrew King, principal investigator for this work at D-Wave. “Tying the magnet up into a topological knot and watching it escape has given us the first detailed look at dynamics that are normally too fast to observe. What we see is a huge benefit in absolute terms, with the scaling advantage in temperature and size that we would hope for. This simulation is a real problem that scientists have already attacked using the algorithms we compared against, marking a significant milestone and an important foundation for future development. This wouldn’t have been possible today without D-Wave’s lower noise processor.”

"The search for quantum advantage in computations is becoming increasingly lively because there are special problems where genuine progress is being made. These problems may appear somewhat contrived even to physicists, but in this paper from a collaboration between D-Wave Systems, Google, and Simon Fraser University, it appears that there is an advantage for quantum annealing using a special purpose processor over classical simulations for the more ‘practical’ problem of finding the equilibrium state of a particular quantum magnet."

(Continued on Page 25)
Kelley Aerospace Officially Launches Supersonic Drone Concept Arrow

The firm says it has already received 100 “pre-orders” for the vehicle.

by Loukia Papadopoulos, 28 February, 2021 (with Permission)

https://interestingengineering.com/kelley-aerospace-officially-launches-supersonic-drone-concept-arrow

Kelley Aerospace has officially launched its supersonic unmanned combat aerial vehicle concept (UCAV) which was teased back in December 2020. The firm says it has already received 100 “pre-orders” for the vehicle, according to a report by Flight Global.

On its site, the company features two drones. The Arrow is said to be the "world's first supersonic UAV that pushes the boundary with state-of-the-art swarm and autonomous aerial flight logic — making it a formidable UAV."

The aircraft features a monocoque (literally single-shell) built from carbon fiber. This makes it lightweight enough to fly more than 2,600 Nm (4,800 km) with a maximum weight of 37,038 lbs (16,800 kg).

"It is designed for a reduced radar cross-section and infra-red signature. The carbon fiber and monocoque design endows the Arrow with outstanding strength and stiffness," said the company in a statement. It is estimated that it will not cost more than $16 million with prices going as low as $9 million. The firm notes that this “allows more airframes to be purchased and yet, have a multi-role supersonic UCAV to perform high-risk missions as it does not necessarily need to return home."

Meanwhile, the Black Eagle is described as "the highest endurance UAV on the market today. It is able to handle a large payload spectrum and is fitted with sensors to achieve its given objective."

The company also revealed that it was working on a supersonic business jet at a launch event in Singapore in December 2020. Two prototypes are currently reported to be undergoing testing in the U.S. and Sweden.

The company also said that it was looking to get some 500 pilots ready to control its combat drones as part of a general aviation pilot academy. But with unmanned technology advancing at the rate it currently is, one can't help but wonder if we'll eventually grow out of the need for highly-trained pilots for operations.
AIAA LA-LV Sustainable Aviation mini-Conference 2021 (Engineers Week)
“Current Topics in Sustainable Aviation, including Biofuels/Sustainable Aviation Fuels, Hydrogen, and Electric Aircraft”
27 February, 2021 | Event Information: https://conta.cc/3c7kx2d (Screenshots only)

A national level event at the local AIAA professional Section (LA-LV).
-Dr. Marty K. Bradley

Dr. Marty K. Bradley
AIAA Fellow
Keynote Speaker and Moderator / Panelist
Senior Technical Fellow, Electra.aero
Technical Fellow for The Boeing Company (ret.)

Mr. Steve Csonka
Speaker / Panelist
President, Csonka Aviation Consultancy, LLC
Executive Director, CAAFI (Commercial Aviation Alternative Fuels Initiative)

Dr. Bruce J. Holmes, D.E.,
AIAA Fellow
Speaker / Panelist
RAeS Fellow
Chief Technology Officer, Alakai Technologies Corporation

Dr. Val Miftakhov
Speaker / Panelist
Founder & CEO ZeroAvia

Dr. Ed Lovelace
Speaker / Panelist
Chief Technology Officer, Ampaire

Zoom Screenshots during the panel discussion.
President Biden Calls JPL to Congratulate the Perseverance Mars Rover Team
6 March , 2021

On March 4, 2021, President Biden video called NASA's Jet Propulsion Laboratory to congratulate the mission team for the successful landing of the Perseverance Mars rover.

The president spoke with JPL director Mike Watkins and Swati Mohan, the mission's guidance and controls operations lead. Team members watched and reacted from various mission support areas around JPL. The team remained masked and socially distant due to the ongoing Covid-19 pandemic.

For more about the mission, visit https://mars.nasa.gov/perseverance

https://www.youtube.com/watch?v=nVBSx2MEiMc
Since the beginning of the Space Age, humanity has had a bird’s eye view of our planet, both day and night. On his first space voyage in 1962, astronaut John Glenn, the first American to orbit the Earth, famously saw the lights of Perth, Australia, switched on especially so he could see them. But it was several decades into the history of spaceflight before researchers’ attention turned to systematically studying what satellite observations of the Earth could tell us about all of that human-caused light in the dark.

Of course, we now know what John Glenn and the people of Perth couldn’t know in the early 1960s: that light pollution is a serious problem. Besides the waste of energy it represents, light pollution harms the natural nighttime environment. It’s also a global issue that touches every country on Earth. But Earth is a big planet, and our ability to understand the problem is hindered by inadequate measurements on the ground. Although we understand well how to sense and quantify the brightness of the night sky, there are many reasons why we can’t easily put measurement equipment everywhere we might like: difficult terrain, political instability, and the destruction of infrastructure in natural disasters.

However, to measure light pollution on Earth, we can look down from above. Beginning in the 1970s, satellites have been launched into space with the necessary equipment for recording signals from light on the night side of Earth. This capability was at first a closely guarded secret of the United States military, but in the early 1990s the Defense Meteorological Satellite Program (DMSP) was declassified and its images of the nighttime Earth made available to civilian researchers. In the years since, other satellites followed, from great ‘earth observatories’ to inexpensive ‘cubesats’, all gathering increasingly detailed views of our planet at night.

These “remote sensing” satellites have contributed in crucial ways to our understanding of the amount and distribution of light pollution around the world. The First World Atlas of Artificial Night Sky Brightness (2001) was humanity’s first truly comprehensive view of the nighttime Earth, and it revealed a remarkable amount of artificial light being emitted into the global night. Improved technology led to better satellite platforms for remote sensing, and in 2016 the atlas received a major update. The New World Atlas of Artificial Night Sky Brightness improved upon its predecessor with better resolution on the ground and increased sensitivity to faint light. It also offered the first formal predictions of the brightness of the night sky, as seen from the ground, made from orbital data. Other researchers built upon this resource with in-depth analyses that showed trends in the prevalence of light pollution on a per-country basis and gave us our most granular view of light pollution to date in certain world geographies. These results have transformed our understanding of light pollution and showed us, to quote the researchers, “the good, the bad, and the ugly” of this issue around the world.

But correctly interpreting what the satellites are trying to tell us is tricky. It’s also crucial in getting our understanding right. For example, if we want to know exactly how much light a detector senses when it’s on orbit, we need to know not only how it performs in the laboratory, but also how it functions when it’s in the “field” of outer space. That turns out to be a very challenging task. We also suffer somewhat in that the resolution of most observations obtained to date from orbit is relatively low; at best we can only resolve light sources down to the level of about an individual city block (with the notable exception of images taken by astronauts aboard the International Space Station). This makes it difficult to tell apart sources of light separated by less than such a distance.

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High School membership with AIAA is a community of students and aerospace professionals who focus on providing activities, competitions, and scholarships that will promote STEM and STEAM educational programs. AIAA will serve as your vital lifelong link to reliable resources and growth opportunities. Join us at the earliest stage of your academic journey and the Institute will help guide you along your path to a rewarding aerospace career!

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https://www.aiaa.org/hs

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If you have questions, please contact AIAA Customer Service at custserv@aiaa.org.
Ms. Khushbu Patel, the AIAA LA-LV STEAM K-12 Outreach Officer/Chair, making the opening remark and welcome everyone.

Officers of the AIAA CSULB Student Branch presenting their projects and operations on aviation and rocketry during the tough COVID-19 Pandemic. Excellent jobs!

(Continued on Page 27)

Part I: Mr. Paul Neuhausen, Mr. Gregory Henk, and Mr. Alan Simmons
Part II: Dr. Kenneth Lui
(Screenshots only)

Mr. Alan Simmons talking (dial-in only) about the designs he made for building the Hyperloop on the Moon (In additional to the Hyperloop TT in California), and the Moonbase with the legendary Space: 1999 Sci-Fi space transporter, the Eagles, assisting the construction of the Lunar Hyperloop and the Moonbase, with Mr. Greg Henk explaining the engineering issues involved.

Mr. Paul Neuhasuen (left) talking about the Hyperloop TT and its main goal and progreses. Mr. Greg Henk (right) explaining in more details about the history of Hyperloop TT, and the differences among Virgin Hyperloop, Elon Musk’s tunnel, and Hyperloop TT, with insights on the Hyperloop in Space (Moon, Mars etc.).

(Continued on Page 29)
AIAA LA-LV Aero Alumni Meeting (17 March, 2021) (Screenshots only)

Dr. Ken Saunders sharing his exciting stories about B-52, after the discussions on the Mars 2020 Perseverance mission the sample return, Jack Bally 1/3 scale B-17 (in Illinois, for sale), COVID-19 vaccine, St. Patrick Day, etc. among the aero alumni.

Dr. Ken Saunders showing the B-52 model he has (given to him by someone), very exciting! Dr. Ken Saunders got his PhD in Applied Mechanics at UC Berkeley in 1965.
AIAA LA-LV e-Town Hall Meeting (20 March, 2021)  
(Screenshots only)
1. Feasible Warp Speeds From Quantum Gravity (Celebrate Black History Month) + Aerospace development in Africa
2. A brief discussion on Quantum Computation and Quantum Supremacy (kick-off for the AIAA LA-LV Quantum (Aerospace) Program/Events)

Part 1: Mr. Stuart Marongwe  
Part 2: Dr. Kenneth Lui


Mr. Stuart Marongwe presenting the possible new approach / concept for space travel based on the theory of quantum gravity.

Mr. Stuart Marongwe talking about the Black History Month, humanity, Pres. Mandela, Albert Einstein, and the American Founding Fathers, asking the audience what they all have in common.

(Continued on Page 30)
Rwandan legislature approves law establishing Rwanda Space Agency

Rwanda’s Chamber of Deputies has voted on the law establishing the Rwanda Space Agency (RSA). This is almost a year since President Paul Kagame approved the draft.

By Daniel Iyanda, 10 March, 2021 (with permission)
https://africanews.space/rwanda-legislature-approves-law-establishing-rwanda-space-agency/

During a cabinet meeting on May 18, 2020, President Paul Kagame had approved the draft law establishing the RSA and said the Agency would start operating from July 2020. But that plan did not work out.

The Chamber of Deputies’ committee on education, technology, culture and youth had been deliberating on the approved draft in consultation with the Ministry of ICT and Innovation. KT Press reported that the committee learnt from the ministry that a policy to inform the agency’s activities was still underway and dependent on the bill approval.

RSA road map, KT reported, will start using space data and images to profile land usage and the construction of “Ground Station Infrastructures” to capture satellite images locally. The ground station will be constructed in the Rwamagana district under a signed contract between Ngali Holding, a Rwandan company, and GlobalStar, an American satellite communications company.

The RSA would send many Rwandans to the United States and Israel to receive training in space technology programmes so they can support Rwanda’s space efforts.

RSA would also manage all space data collected in public and private institutions. If selling this data, the agency will first analyze it before distributing or selling on the local market.

Rwanda was involved in two satellites in 2019: the RWASAT-1 and Icyerekezo. The RWASAT-1 carried a communication payload that will collect and forward data to remote monitoring stations on the ground. And Icyerekezo, which means vision in English, enabled the government to provide internet to more remote schools across the country. RWASAT-1 was launched in partnership with the Japanese Aerospace Exploration Agency (JAXA). Icyerekezo was launched in partnership with OneWeb, a United Kingdom-based communications company OneWeb.

In August 2020, the Office of the Prime Minister had named Lt. Col Francis Ngabo as the CEO of RSA. And the Agency also created its official Twitter page on December 14, 2020.

With the launch of RSA, only 20 of the 55 African countries have a space agency, institution, programme or are seriously engaging in space activities.
Sixty-four years ago this month, the public got its first view of a painting of the Moon that had taken Chesley Bonestell over a year to complete. The Museum of Science in Boston had commissioned him to create an enormous ten-by-forty-foot mural of the lunar surface for their Charles Hayden Planetarium.

The mural was created in California with Chesley’s wife, Hulda, serving as his artistic assistant. Due to its size, the painting was made in three sections at Chesley’s studio in Altadena. Bonestell historian and Co-Producer Melvin Schuetz also notes “The canvasses were so large that he had to work on them in his backyard.” The sections were then trucked to Boston and Chesley arrived to touch up the seams so that it all appeared to be one massive painting. Unveiled on March 27, 1957, A Lunar Landscape gave museum visitors the experience of what they might see if they were astronauts exploring the Moon. The painting’s stark vistas showed tall mountain ranges with sharp, craggy peaks. In an article by Dr. Tom Crouch, The Smithsonian's National Air and Space Museum Senior Curator Emeritus, Chesley is quoted as saying, “I tried to make it as dramatic as I could.” The exhibition proved to be quite popular but a drama of another kind began slowly brewing around this painting.

At that time, the Soviet Union (known today as the Russian Federation) and the United States were competitors in what was called “The Space Race.” Which nation would be the first to orbit a satellite around the Earth or land a man on the Moon? On October 4, 1957, the Soviets moved ahead when they launched Sputnik 1 successfully into orbit. We would have Explorer 1 circling the Earth months later. The USSR would go on to achieve additional milestones when its Luna 2 became the first spacecraft to reach the Moon (it crashed there). Their Luna 3 was the first spacecraft to photograph the far side of the Moon. In 1966, Luna 9 became the first spacecraft to perform a soft landing on the lunar surface, soon followed by America’s Surveyor 1. That summer, our Lunar Orbiter 1 became the first in a series of spacecraft to send back pictures of possible landing sites for the Apollo astronauts. The five Surveyors that successfully landed sent back images that showed a different lunar landscape than the one Chesley had painted in his mural. Mountain ranges and crater rims looked soft and rounded-off due to eons of micrometeorite bombardment.

In 1969, the United States emerged as the winner of the Space Race when Neil Armstrong and Buzz Aldrin landed on the Moon. Historic television images of the two astronauts and the photographs they took, however, made it apparent that Chesley’s painting, while beautiful to behold, wasn’t really what the lunar surface looked like. In our film, Chesley Bonestell: A Brush With The Future, Chesley confides, “I was very much annoyed with what I’d done. I showed all these sharp mountains and craggy things because I thought that they’d be split and broken and all that.”
Be Green, Keep Flying!
USAIRE Student Awards – Be Green, Keep flying – 2020
by Christine LIN & Chiu-Yueh BLAISE

INTRODUCTION

Global warming and its accelerated evolution are concerning issues. Civil aviation is responsible of 2.6% [2] Carbon Dioxide (CO₂) emission per year. A 4% [3] year growth is assumed and without any improvement this will lead to triple the emissions and this without even taking other emitted gas such as Nitrogen Oxides (NOx) into account. The aeronautical domain is aware of its ecological impact and is already changing with the challenge to have a zero-emission aircraft by 2050 [2]. In the meantime, while writing this document, the aviation industry is facing the COVID-19 pandemic, its weaknesses are showing up [4], sometimes stopping research programs, as the E-Fan X project [5], that could have given significant results for future aircraft. What if this situation was just the premise of what could happen to the industry if no ‘green aircraft’ were designed on time to face global warming? The pandemic increases the urge of not only going towards but actually creating an eco-friendly aircraft and making sure it is going to be the most common aircraft used in the future.

Starting with a critical appraisal to determine the pros and cons of new technologies used to reduce energy consumption and help define a more environmentally friendly future aircraft, operation of those aircraft with current measures and infrastructures show some issues that will need to be resolved. Eventually, changes in aircraft domain will have some social, political, and financial changes.

1. Considering the importance of going green, new technologies are all mobilized to help create an eco-friendly aircraft that certainly will change the course of history.
2. However, our current infrastructures and implemented measures are causing some issues in the fulfilment of our objective.
3. If we manage to go through these different obstacles, the society might go through major changes (be it political, social or financial changes).

NEW TECHNOLOGIES FOR INCREASED AIRCRAFT PERFORMANCES

Aircraft are complex vehicles and are mainly constituted of a single fuselage and wing, a propulsion system under the wings or at the rear of the fuselage, with a tail plane and an empennage. Current aircraft are already highly optimised but new solutions can certainly help improve the change needed to both go green and keep flying.

New propulsion energy (Fuels)

Since the beginning of aviation, propulsion emissions drastically decreased as their efficiency improved [6]. As an example, the Leap engine is consuming 15% less fuel than its predecessor [7]. Nevertheless, despite all the progress made, fuel extraction is decreasing in the world as its stock of fuel are running lower and lower [8][9]. Therefore, new solutions need to be adopted.

A way of reducing emissions during flight can be achieved with a new propulsive energy, that is to say by changing the fuel used. Two new energies are emerging: Biofuels and (Continued on Page 33)
Kelly Latimer was a research pilot in the Flight Crew Branch of NASA's Dryden (now Armstrong) Flight Research Center from March through November 2007 and flew the T38, T-34, G-III, C-17, and the Ikhana/Predator B.

Latimer was the center's first female research test pilot. Prior to joining NASA, Latimer was on active duty with the U.S. Air Force. She accumulated more than 5,000 hours of military and civilian flight experience in 30 aircraft.
The Daniel Guggenheim Medal: 1950 Medalist: Dr. Hugh Latimer Dryden

https://www.aiaa.org/guggenheim/, https://www.aiaa.org/guggenheim/medal-recipients

(This Award is administrated by AIAA)

The Daniel Guggenheim Medal was created as an international award for the purpose of honoring suitable persons, and it is also a commemoration of the support given by Daniel Guggenheim to the advancement of aeronautics through donations for the support of schools of aeronautics and for the encouragement of civil aviation. While it has been impossible in the short life of the Medal Board to include every aeronautical pioneer worthy of recognition in the list of Medalists, this list spans the entire history of practical aviation development. The Medal, very properly, is regarded by many as the greatest honor that can be presented for a lifetime of work in the aeronautical field.

MEDALIST FOR 1950 For outstanding leadership in aeronautical research and fundamental contributions to aeronautical science.

Dr. HUGH LATIMER DRYDEN

Hardly a phase of the rapidly developing flight sciences exists which has not been materially shaped and enhanced by the research and administrative career of Hugh Latimer Dryden. Born July 2, 1898, at Pocomoke City, Maryland, he earned his way through The Johns Hopkins University. Greatly influenced by Dr. Joseph S. Ames, one of the pioneers in aerodynamics, he did his graduate work in physics, receiving his Ph.D. from Johns Hopkins in 1919. At the age of 21, Dryden was named Chief of the Aerodynamics Section of the Bureau of Standards. In 1924, with L. J. Briggs, he made some of the earliest measurements of the aerodynamic characteristics of airfoils near the speed of sound. Five years later, with A. M. Kuethe, he published the first of a series of important papers on the measurement of turbulence. In 1934 he was made chief of the Mechanics and Sound division of the Bureau of Standards, and in January 1946 Assistant Director of the Bureau. In the same year he was promoted to Associate Director. During the second World War he was charged with guiding development of Bat, the radar-homing missile used by the Navy against the Japanese. He also served on committees dealing with guided missiles under the sponsorship of the Joint Chiefs of Staff, the NACA, the Ordnance Department of the Army, and the Army Air Forces. After the war he continued to take an important part in the missile development program of the Bureau of Standards. In September 1947, after more than 29 years of service there, Dryden left the Bureau of Standards to become Director of Aeronautical Research of the National Advisory Committee for Aeronautics. In 1949 his responsibilities were again increased: he became Director of NACA.

The launching of Sputnik I by the Soviet Union on October 4, 1957, led to intensive consideration of the objectives of the United States in the exploration and exploitation of space, and of the form of organization required to realize these objectives. On July 29, 1958, the National Aeronautics and Space Act established a new civilian agency, the National Aeronautics and Space Administration, terminating NACA and transferring its functions to the new agency. Dryden was named Deputy Administrator of NASA by President Eisenhower and continued to serve in this capacity under President Kennedy.

In addition to his other duties, Dryden served as a member of many scientific committees advising government agencies, including the Department of Defense and the military services. He was adviser to the Science Advisory Committee to the President, a member of the Standing Committee of the Federal Council on Science and Technology, a member of the Defense Science Board, Technical Adviser to the U.S. Representative on the United Nations Committee on the Peaceful Uses of Outer Space, and national delegate to the NATO Advisory Group for Aeronautical Research and Development. He died December 2, 1965.
CASISS Releases Two ISS National Lab Research Announcements For In-Space Production Applications

22 March, 2021 (with permission)
https://www.issnationallab.org/iss360/release-two-nlra-ispa/

KENNEDY SPACE CENTER (FL), March 22, 2021 – The Center for the Advancement of Science in Space (CASIS), manager of the International Space Station (ISS) U.S. National Laboratory, today released two separate research announcements that will solicit proposals within the area of in-space production applications. Applied research and development concepts in this area seek to demonstrate space-based manufacturing and production activities that enable new business growth and capital investment, represent scalable and sustainable market opportunities, and produce reoccurring value with the potential to generate demand for and revenue from access to space. These two in-space production applications research announcements are in the focus areas of: 1) Advanced Manufacturing and Materials and 2) Tissue Engineering and Biomanufacturing.

Advancing in-space production applications onboard the space station has been identified as a strategic priority for both NASA and the ISS National Lab. Enabling opportunities and driving demand within this area will be instrumental in the development of a robust and sustainable market in low Earth orbit. Through opportunities such as these research announcements, CASIS aims to reach both existing ISS investigators and potential new space station users. Flight projects selected via these research announcements may be awarded funding to enable mission integration and operations support for projects that will be implemented on the ISS. Below provides further information on both of these research announcement opportunities.

ISS National Lab Research Announcement 2021-5: In-Space Production Applications for Advanced Manufacturing and Materials

Through this research announcement, CASIS seeks proposals in the areas of advanced or exotic materials production and/or associated technologies. Suggested topics within this focus area include the following:

- **Thin-layer deposition**: Creating and depositing thin film coatings onto a substrate material with the ability to design in certain properties that improve the performance of the material
- **Crystal growth and/or production improvements**: Crystallization of small organic molecules or large biomolecules, production of uniform crystals, or growth of inorganic crystals
- **In-space production or metallurgical development**: The development of next-generation production methods, the synthesis and testing of novel materials, and the exploitation of mechanisms involved in material transformations for the production of new materials with unique characteristics
- **Process improvements**: Use of the ISS to develop and support the use of hardware and production techniques/approaches focused on the production of materials for in-space use and/or terrestrial applications

ISS National Lab Research Announcement 2021-6: In-Space Production Applications for Tissue Engineering and Biomanufacturing

Through this research announcement, CASIS seeks proposals in the areas of regenerative medicine and/or associated technologies that may benefit from the unique environment of the ISS. Suggested topics within this focus area include the following:

- **Stem cells**: Studies that demonstrate the benefits of stem cell expansion and/or stem cell research in space for therapeutic application(s) on Earth
- **Organoid or multicellular systems**: Studies that demonstrate an organoid culture or multicellular culture system to model human disease or test therapeutics to treat disease
- **Biofabrication of tissues or other biocompatible material**: Studies that develop and demonstrate a system for the in-space biofabrication of tissues or other biocompatible material

CASIS will host two webinars to discuss ISS facilities and capabilities associated with these research announcements. The Advanced Manufacturing and Materials webinar will be held on April 6, 2021 at 1 p.m. EST, and the Tissue Engineering and Biomanufacturing webinar will be held on April 8, 2021 at 1 p.m. EST. For those unable to attend the webinars, recorded versions will be included on the research announcement webpages.

Both of these research announcements will follow a two-step proposal submission process. Before being invited to submit a full proposal, all interested investigators must complete and submit a Step 1 Concept Summary for review. Step 1 Concept Summaries must be submitted by end of day on May 6, 2021. Step 2 Full Proposals (from those invited to submit) will be due by end of day June 22, 2021.

To learn more about these opportunities, including how to submit a Step 1 Concept Summary, please visit the webpage for each research announcement (Advanced Manufacturing and Materials; Tissue Engineering and Biomanufacturing). To learn more about the ISS National Lab and the science that it sponsors, please visit www.ISSNationalLab.org.
Several Technology Development Payloads Sponsored by the ISS National Lab Launching on Northrop Grumman CRS-15

17 February, 2021 (with permission)

https://www.issnationallab.org/iss360/issnl-sponsored-tech-dev-payloads-ng-crs-15/

KENNEDY SPACE CENTER (FL), February 17, 2021 –

On Saturday, February 20, no earlier than 12:36 p.m. EST, Northrop Grumman is scheduled to launch its Cygnus spacecraft on an Antares rocket to the International Space Station (ISS), marking its 15th mission under NASA’s Commercial Resupply Services (CRS) program. The launch, which will take place from NASA’s Wallops Flight Facility in Virginia, will deliver thousands of pounds of critical supplies and research to the space station. Moreover, many of the payloads on this mission showcase the diversity of research sponsored by the ISS U.S. National Laboratory, with investigations in the physical and life sciences, materials research, and the validation of new facilities that further research and development in low Earth orbit.

Of note, the ISS National Lab is sponsoring a number of technology development payloads on Northrop Grumman CRS-15. By supporting technology development investigations on the orbiting laboratory, the ISS National Lab serves as a business incubator in space, enabling advancements not possible on Earth that help to drive a robust and sustainable market in low Earth orbit. Additionally, insights gained from such projects can be used to improve products and processes that will produce positive economic impact. Below are some of the investigations sponsored by the ISS National Lab that are launching on Northrop Grumman CRS-15.

In 2017, engineers from Hewlett Packard Enterprise launched a high-performance computer, called the Spaceborne Computer, to test whether a commercial off-the-shelf computer system without any hardware modifications could operate seamlessly in the extreme conditions of space. Based on this success, the team will now launch its second iteration of the Spaceborne Computer—this time delivering twice the computational power and providing in-space data processing capabilities. Using Spaceborne Computer-2, researchers may see improvements in the ability to process and analyze data onboard the ISS rather than sending the data back to Earth for analysis, enabling faster results and greater potential for in-space iteration of research.

Crystals grown in microgravity are often larger and more well-ordered than Earth-grown crystals—and over the years, crystal growth has been an important area of research on the ISS. On this mission, Redwire will launch its Industrial Crystallization Facility (ICF), the sixth commercial facility the company has developed for testing and use on the ISS. The ICF will provide a space-based platform for the growth and formulation of centimeter-scale single crystals and other exotic materials for use in the optics and sensor industries. Validation of the ICF will also provide a proof of concept for applied industrial materials production in microgravity, which will be an important in-orbit research and development capability in the future.

Three separate investigations launching on this mission will utilize the MISSE Flight Facility—a platform operated by Alpha Space on the exterior of the ISS that exposes samples to the harsh space environment, which includes extreme temperature variations, enhanced radiation levels, and atomic oxygen. These investigations include an agricultural investigation evaluating the effects of the space environment on barley seeds, an academic study examining how phosphor powders and composites react in space, and a private-sector experiment testing the durability of 3D printed radio frequency circuits in space for potential use in future small satellites.

LambdaVision, an innovative biomedical startup, will launch its second investigation focused on protein-based artificial retinas that could restore high-resolution vision and enhance the quality of life for patients with retinal degeneration. The company, in collaboration with Commercial Service Provider Space Tango, seeks to leverage the space station’s constant microgravity environment to improve the manufacturing process for artificial retina production. Results may accelerate pathways to improve patient care on Earth and further in-space production efforts on the ISS.

To learn about all of the payloads sponsored by the ISS National Lab that are launching on Northrop Grumman CRS-15, please visit our launch page.

About the International Space Station (ISS) U.S. National Laboratory: The International Space Station (ISS) is a one-of-a-kind laboratory that enables research and technology development not possible on Earth. As a public service enterprise, the ISS National Lab allows researchers to leverage this multiuser facility to improve life on Earth, mature space-based business models, advance science literacy in the future workforce, and expand a sustainable and scalable market in low Earth orbit. Through this orbiting national laboratory, research resources on the ISS are available to support non-NASA science, technology and education initiatives from U.S. government agencies, academic institutions, and the private sector. The Center for the Advancement of Science in Space (CASIS) manages the ISS National Lab, under cooperative agreement with NASA, facilitating access to its permanent microgravity research environment, a powerful vantage point in low Earth orbit, and the extreme and varied conditions of space. To learn more about the ISS National Lab, visit www.ISSNationalLab.org.
**The Spaceborne Computer Returns to the ISS**

by Norm Follett, Guest Contributor, Hewlett Packard Enterprise, 10 February, 2021 (with permission)


**Northrop Grumman CRS-15: Hewlett Packard Enterprise Spaceborne Computer (Video):**

[https://www.youtube.com/watch?v=tdbie_vceRQ&t=2s](https://www.youtube.com/watch?v=tdbie_vceRQ&t=2s)

Hewlett Packard Enterprise (HPE) is excitedly awaiting its return to the International Space Station (ISS) with its Spaceborne Computer-2 (SBC-2) system—and you should be too! HPE and the ISS U.S. National Laboratory invite project ideas for featured experiments utilizing SBC-2 during its next round of operations on the ISS. During its mission, HPE will make SBC-2 available to ISS National Lab users for conducting experiments that demonstrate the computer’s capabilities, assist users with their computer processing requirements, and fulfill HPE’s mission objective of further demonstrating onboard state-of-the-art artificial intelligence (AI) and edge computing capabilities.

Having completed flight certification and manifested for launch onboard Northrup Grumman’s 15th commercial resupply services (CRS) mission in early 2021, the SBC-2 project and system builds upon the success of its predecessor, Spaceborne Computer-1 (SBC-1). The upcoming mission focuses on bringing an entirely new level of onboard supercomputer capability to the ISS as well as earthbound researchers. With this capability on the ISS comes a new and exciting research opportunity for organizations to “come onboard” and conduct their own experiments leveraging the SBC-2 system.

The original SBC-1, which launched on SpaceX CRS-12 on August 14, 2017, served primarily as a proof of concept to demonstrate that a commercial off-the-shelf (COTS) computer system with supercomputer capabilities could operate in space for at least a year. Its successful mission withstood the challenges of the harsh environment of space, where variable gravitational forces, fluctuating radiation exposure, and galactic cosmic rays are a daily occurrence.

![NASA astronaut Christina Koch prepared Spaceborne Computer-1 for its flight home on April 30, 2019, after 657 days of 24x7 operations onboard the ISS. (Media Credit: Image courtesy of NASA/HPE)](https://www.nasa.gov/)

Exceeding original mission objectives, this self-contained, water-cooled, and solar-powered system enjoyed an eight-month mission extension, where additional computational tasks, not previously scoped, were performed at the request of NASA and its partner agencies. This included simulation runs of the Onboard Autonomous Trajectory Planner (OATP) software in preparation for use in future Mars missions. The final flight log of SBC-1 is impressive—53,936 runs executed flawlessly during the course of 9,562 orbits while dealing with 6,879 crossings of the South Atlantic Anomaly (a weak spot in Earth’s magnetic field with an increased flux of energetic particles and higher levels of radiation that can interfere with computer operation).

It was clear to all involved that lessons learned from the SBC-1 experiment would have a profound impact on the economics and computational capabilities of future space missions. The ability to show that as part of future explorations it would be possible to leverage market dynamics and technological innovations in off-the-shelf computational architectures to apply in a real-time, reconfigurable, affordable format during spaceflight would be profound. By removing the burden of developing proprietary computer systems for space exploration from government agencies and aerospace contractors and shifting the definition of computational requirements to private-sector companies that specialize in the field, the results would be technically advanced, fiscally prudent, and flight schedule friendly.

By netting a series of acknowledgements on its accomplishments, the SBC-1 project enjoyed the computer version equivalent of a ticker tape parade upon its return. Noteworthy in that list included receiving a NASA Exceptional Technology Achievement Medal, the Top HPC-Enabled Scientific Achievement (HPCWire), the 2018 International Space Station Innovation Award in Technology Development and Demonstration, the HPC Innovation Excellence Award (Hyperion Research), and the Top Supercomputing Achievement (HPCWire).

**Advancing Research with Spaceborne Computer-2**

With advanced HPE Edgeline Converged Edge Systems and HPE ProLiant DL360 systems as part of the configuration of SBC-2, the next mission will expand upon the first mission’s success by allowing the ISS crew and researchers using the ISS to take advantage of onboard state-of-the-art artificial intelligence and high performance compute (HPC) capabilities. In addition, earthbound scientists in commercial and educational sectors will be able to take advantage of these capabilities as well. This mission, unlike its predecessor, is not about “can we do it,” but now “how can we use it” to advance our knowledge on a variety of topics that the insight of space-based experimentation can deliver.

HPE will also test new software technologies for recovering and mitigating transient memory defects and other errors during operations in space. These test results will aid the development of product lines for space and harsh Earth environments. Building upon the success of our original mission, the SBC-2 effort will focus on the ISS and space research community with outreach, support, and training in the use of onboard data, signal, and other compute processing.

To learn more about the SBC-2 mission and how to submit potential experiments, email spaceborne@hpe.com.

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**Note:**

NASA astronaut Christina Koch prepared Spaceborne Computer-1 for its flight home on April 30, 2019, after 657 days of 24x7 operations onboard the ISS. (Media Credit: Image courtesy of NASA/HPE)
Ampaire and Surf Air Mobility Join Forces for Electric Future of Aviation

(Continued from Page 1)

We’ve been working quietly over the past year with Sudhin Shahani, Surf Air Mobility’s visionary CEO and his leadership team. Our talks revolved around a shared vision — of an electric aviation future that moves inexorably toward zero emissions. In the process, our own leadership team was instrumental in defining the mission, vision, values and strategy that led to the formation of Surf Air Mobility and decision to integrate our companies. In many ways, it is as much a direct extension of Ampaire’s founding mission as it is Surf Air’s—something that will set us up for success as we continue this new phase together.

With Surf Air Mobility, the electric revolution will happen faster. Together, we combine all the critical components to accelerate adoption of electric flight, substantially reducing the cost and environmental impact of aviation, unlocking a new world of travel for everyone. This new entity is vertically integrated, encompassing electric aircraft technology, scheduled flight operations and a passenger demand aggregation platform.

We want to offer people everywhere a clean, swift alternative to both the automobile and conventional aircraft for regional travel. We also want to improve air links to rural communities. The key is to lower cost by replacing expensive and polluting hydrocarbons with low-cost, renewable electrons. There has never been a more important moment to help knit together urban and rural areas. That is one of the promises of electric aviation.

I am immensely excited for the future we are building, and we are uniquely positioned to be the market leader in sustainable aviation and to change the world for the better, faster.

Want to be part of the revolution? Let us know.
First IRBM Intercept – 60 Years Ago (Continued from Page 2)

The test missile defense system at Saryshagan, System A, included a long-range search and acquisition radar Dunai-2 (Hen Roost) to detect the incoming missile. Then three precise tracking and guidance radars (RTNs) tracked the approaching warhead and guided the intercepting missile toward it. The widely separated RTNs formed an equilateral triangle, accurately measured their distances to the target, and determined its absolute position by the method of three respective distances. The V-1000 interceptor missile exploded its fragmentation warhead, destroying the target.

Kisunko directed the follow-on design and deployment of the nuclear-armed operational missile defense system A-35 around Moscow. Disagreements on the future development in missile defense and power struggle in the defense establishment led to his firing in 1975. His legacy of scientific and engineering achievement, cemented on March 4, 1961, remains.

Today, many countries continue or consider development of missile defenses. This consequential field is highly politicized in the United States, as much as global warming and response to the pandemic. As in the past, opponents of missile defense believe that no technical means exist to protect against ballistic missile threats and preach arms control. Others advance development of technical means to provide defense, even limited, and thus give leaders of their countries additional dimension in responding to existential national security threats.

Israel spectacularly demonstrated the latter with the successful Iron Dome system and its successors. The United States deployed operational interceptors in Alaska and California focused on a particular threat from North Korea.

Historically, a bold initiative in missile defense, the Strategic Defense Initiative, played a critical role in ending the Cold War. No wonder that political opponents and their media associates disparaged SDI, calling it a “Star Wars” program.

As we look back at the 1961 achievement and its importance for science, technology, geopolitical struggle, and the Cold War, we face the exactly same question that then Chief of Naval Operations Adm. James Watkins formulated in 1983,

“Wouldn’t it be better to protect the American people rather than avenge them?”

More than 60 years ago, the pioneers blazed the trail in search of technical means for defense against deadly ballistic missiles. As life goes on and new threats emerge, the eternal competition between the sword and the shield continues.

Article (free download) from "Proc. IEEE" on the Intercept 1961 --

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Prof. Mike Gruntman
Professor of Astronautics, PhD
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Professor of Astronautics; physicist, engineer, and historian. Founding Chairman (2004-2007) of a unique in the U.S. space-focused academic unit - Department of Astronautical Engineering (ASTE) - in the USC Viterbi School of Engineering. ASTE Chairman: 2016-2019. (Holds USC joint appointment as Professor of Aerospace Engineering.) Space physicist and space engineer. Specialist in astronautics, space exploration, space technologies, space applications, rocket and spacecraft propulsion, rocketry, space plasmas, space environment, space sensors, science instrumentation, space missions, spacecraft design, and spacecraft technologies; history of rocketry, spacecraft, and missile defense; space education. 300+ scholarly publications, including 4 books -- http://astronauticsnow.com/MikeGruntman/mg_p_lst.html

Short courses on space systems (AIAA, ATI) to industry and (friendly) governments -- http://astronauticsnow.com/courses/ . AIAA Distinguished Lecturer
Missile defenses did not stop rocket attack in Iraq
(Continued from Page 3)

rockets was seen by spy satellites, although this has not been reported. Prior warning allowed time for personnel to enter hardened shelters and for vital equipment to be removed from the base.

The lack of an effective air defense system combined with the elusiveness of the enemy suggests that the US cannot passively defend its forward-based forces in places such as Iraq or Syria. There are three alternative defense possibilities: 1) Pull US troops out of indefensible bases; 2) develop air defenses that can handle all threats; 3) attack the source of the missiles.

In regard to removing US troops from these bases, sentiment is growing in Washington that this could be the only viable near-term solution. Think tanks like Rand and organizations such as the Atlantic Council have been drawing up plans to facilitate a US pull out from Iraq. Removing US troops does not preclude the third option of going after the sources of the threat. In current conditions US forces and US contractor personnel are no more than hostages to the enemy.

The US Army is working on an integrated air defense system; however most of the focus is on drones and cruise missiles. These are much slower flying threats than Katyusha rockets and fly over considerably longer distances, allowing a good response time once detected. But even if a comprehensive solution is developed, fielding it is five to ten years in the future, leaving forces in Iraq and elsewhere unprotected in the interim.

The third option, going after the source of the attack, as US President Joe Biden did after a US contractor was killed and eight others wounded in Erbil on February 15, also by Katyusha type rockets, does not assure that it will stop subsequent attacks, as the attack on Ain al-Asad airbase clearly shows. The reason for this is that the militias who launch the rockets, some with new names to avoid definitive identification, but most regarded as pro-Iran militias, are taking their orders from either Tehran or from the Iranian Islamic Revolutionary Guard Corps. Hitting the militias did not stop the rocketing of Ain al-Asad.

The US has not responded to Iranian-sponsored attacks by striking Iran, and neither has Saudi Arabia, which has suffered attacks from Iranian proxies in Yemen and with direct attacks from Iran in the case of the Khurais and Abqaiq oil installations in September 2019. On February 27 of this year, a combined ballistic missile and drone attack on the Saudi Capital of Riyadh took place where both the drones and missiles have been attributed to the Houthis in Yemen, Iranian proxies, but may also have been launched from either Iran or nearby northern Iraq. Yemen is far from Riyadh and the type of missile and drones used are different from those known to be in the hands of the Houthis. For example, the drone remains found after the attack appear similar if not identical to the drones used in the Abqaiq attack. The drone attack was aimed at the Saudi Royal Palace.

Fortunately, in the attacks on February 27, Saudi air defenses, particularly the Patriot GEM-T interceptors destroyed the incoming ballistic missiles.

Both the US and Saudi Arabia do not want a war with Iran, affording Iran the unique luxury of killing US troops and contractors and destroying infrastructure in both countries. And, while the US can pull its troops out of Iraq, Saudi Arabia has no such option.

In the meantime, protecting US bases abroad will remain challenging, perhaps impossible.
D-Wave Demonstrates Performance Advantage in Quantum Simulation of Exotic Magnetism (Continued from Page 4)

magnet,” said Prof. Dr. Gabriel Aeppli, professor of physics at ETH Zürich and EPF Lausanne, and head of the Photon Science Division of the Paul Scherrer Institute. “This comes as a surprise given the belief of many that quantum annealing has no intrinsic advantage over path integral Monte Carlo programs implemented on classical processors.”

“Nascent quantum technologies mature into practical tools only when they leave classical counterparts in the dust in solving real-world problems,” said Hidetoshi Nishimori, Professor, Institute of Innovative Research, Tokyo Institute of Technology. “A key step in this direction has been achieved in this paper by providing clear evidence of a scaling advantage of the quantum annealer over an impregnable classical computing competitor in simulating dynamical properties of a complex material. I send sincere applause to the team.”

“Successfully demonstrating such complex phenomena is, on its own, further proof of the programmability and flexibility of D-Wave's quantum computer,” said D-Wave CEO Alan Baratz. “But perhaps even more important is the fact that this was not demonstrated on a synthetic or ‘trick’ problem. This was achieved on a real problem in physics against an industry-standard tool for simulation—a demonstration of the practical value of the D-Wave processor. We must always be doing two things: furthering the science and increasing the performance of our systems and technologies to help customers develop applications with real-world business value. This kind of scientific breakthrough from our team is in line with that mission and speaks to the emerging value that it’s possible to derive from quantum computing today.”

The scientific achievements presented in Nature Communications further underpin D-Wave’s ongoing work with world-class customers to develop over 250 early quantum computing applications, with a number piloting in production applications, in diverse industries such as manufacturing, logistics, pharmaceutical, life sciences, retail and financial services. In September 2020, D-Wave brought its next-generation Advantage™ quantum system to market via the Leap™ quantum cloud service. The system includes more than 5,000 qubits and 15-way qubit connectivity, as well as an expanded hybrid solver service capable of running business problems with up to one million variables. The combination of Advantage’s computing power and scale with the hybrid solver service gives businesses the ability to run performant, real-world quantum applications for the first time.

The paper published today is available here in Nature Communications. A Medium post about the work can be found here.

About D-Wave Systems Inc.

D-Wave is the leader in the development and delivery of quantum computing systems, software and services and is the world’s first commercial supplier of quantum computers. Our mission is to unlock the power of quantum computing for the world. We do this by delivering customer value with practical quantum applications for problems as diverse as logistics, artificial intelligence, materials sciences, drug discovery, cybersecurity, fault detection, and financial modeling. D-Wave’s systems are being used by some of the world’s most advanced organizations, including NEC, Volkswagen, DENSO, Lockheed Martin, USC, and Los Alamos National Laboratory. With headquarters near Vancouver, Canada, D-Wave’s US operations are based in Palo Alto, CA and Bellevue, WA. D-Wave has a blue-chip investor base including PSP Investments, Goldman Sachs, BDC Capital, NEC Corp., and In-Q-Tel. For more information, visit: www.dwavesys.com.
New Research Strengthens Ability to Monitor Light Pollution From Orbit

(Continued from Page 8)

The most stubbornly persistent issue with satellite remote sensing observations of night lights is a “haze” of light seen around cities: is it real, or is it an illusion introduced by the optics or the electronics of our satellite-based cameras? The haze is illustrated in the false-color image below, showing a satellite image of the city of Chicago, U.S., and adjacent Lake Michigan. Although we know there is no light being emitted over the lake, the purple tones indicate light sensed by a satellite that seems to get fainter at larger distances away from the city.

For nearly 30 years, the haze was thought to be the result of sensing very bright light coming from cities, causing the digital detectors to “saturate”. Note that the city center of Chicago, just below and to the left of the image above, registers as a solid yellow color: so much upward-directed light originates there that the satellite detector is overwhelmed and can no longer provide information about how the light is actually distributed. If that “extra” light over the lake is not real, we might be over-counting light emissions from those areas and get the wrong answer. But if the light is real and we discard it as an artifact, it causes those areas to be under-counted and makes some palaces on Earth appear darker than they really are.

Brand-new research by Alejandro Sánchez de Miguel (University of Exeter, UK) and co-workers contends the haze is real light from cities, scattered up to the satellites, and that it should be included in our measurements. They demonstrated this by matching satellite observations to data from a network of ground sensors taken at the same time, showing a very strong correlation. By accounting for the scattered light, the authors improved on the sky brightness predictions from the New World Atlas of Artificial Night Sky Brightness and can make more accurate estimates of sky brightness anywhere in the world. “The diffuse light around cities in nighttime satellite imagery of the Earth has often been interpreted as instrumental error,” they write. “Here we have shown that this is not the case.”

They have made available to the public an early version of a website where users can see trends in predicted night sky brightness at any location. The example below shows the city of Madrid, Spain; the false colors indicated by the color bar correspond to the predicted brightness of the night sky one would see from each location on the map.

The researchers caution, however, that at this stage the relationship between satellite readings and night sky brightness in cities is not yet fully understood, and that their models currently do not predict the sky brightness in cities very well. Work continues to better understand the relationship between the amount of light emitted by cities, as seen from the vantage point of orbital satellites, and the amount of skyglow residents of those cities experience.

Why is this new result important? Again, quoting the authors: “It should be possible for a future space-based imaging radiometer to monitor changes in the diffuse artificial skyglow of cities.” As the world’s population becomes increasingly urban, cities are where light pollution’s influence is growing the fastest — especially in developing economies. Accurate estimates of light pollution made from satellites can help us follow the evolution of the threat without relying as much on ground-based monitors.

It also indirectly makes a case for a new, dedicated ‘night lights observatory’ spacecraft mission designed specifically for that purpose, whereas satellite capabilities to date have largely included the ability to measure light pollution almost as an afterthought. For example, the latest satellite sensor with global coverage, the Visible Infrared Imaging Radiometer Suite Day-Night Band (VIIRS-DNB), is almost completely insensitive to the strong blue-light emissions of white LED lighting products. As a result, the VIIRS-DNB has largely missed the rise of the lighting technology that is quickly coming to dominate light pollution in many countries. A dedicated night lights mission that overcomes these technical challenges could be the key to identifying the parts of the world most in need of attention in our ongoing effort to fight light pollution.

View Full Research Press Release

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engage.aiaa.org/losangeles-lasvegas
AIAA LA-LV University Student Branches mini-conference 2021 (6 March, 2021)  
(Screenshots only) (Continued from Page 10)

Ava Badii, USC RPL Student Rocket Team, talking about the new development for the Student-run rocket team.

Mr. Phil Barnes, showing the simulation / animation of the electric aircraft with aerodynamic utilizing the air-vehicle interaction energy, learning from the Nature/birds.

Members from the UCLA Student Branches talking about their projects and plans for the coming year, and how they combated the tough situations due to COVID-19 Pandemic.  
(Continued on the next page)
The panelists enthusiastically sharing great advice and experiences with the students and attendees about how to find opportunities and cope with life and schools/jobs during the COVID-19 Pandemic and in general, also participating in the breakout sessions to help the students 1-1, which many students and panelists found very interesting and beneficial.

(Left) Mr. Jyot Bawa (L.A. Gauge) giving a talk on career advice and working environment; (Right) Mr. Bill Kelly sharing the new information about the first day at work he asked recently from some aerospace professionals, to help the students.

Dr. Nahum Melamed (Aerospace Corp.) talking about the exciting / inspiring Planetary Defense App development and the importance of the Planetary Defense, while also showing the job opportunities and the approaches to apply for them.
AIAA LA-LV e-Town Hall Meeting (13 March, 2021):
Hyperloop: the Next Phase | AIAA Engage & Discussion Board
(Continued from Page 11)

(Left) Mr. Greg Henk and Mr. Alan Simmons explaining the plans of Hyperloop TT connecting Los Angeles and San Francisco with the art/design by Mr. Simmons; (middle) Lunar Rover and Moonbase, and (right) Space Station, designed by Mr. Simmons.

Dr. Ken Lui explaining the features of AIAA Engage and Discussion Board, what the AIAA Engage is and isn’t, and the ways to get the most of it! The more you use it, the more you benefit from it and enjoy it.

(Right) Job search for employers and job seekers; (lower left) Open Forum for posting your message to all the AIAA members and Communities; (lower right) Mentor / Mentee enrollment and matchmaking, all on the AIAA Engage!
AIAA LA-LV e-Town Hall Meeting (20 March, 2021)  
(Screenshots only)

1. Feasible Warp Speeds From Quantum Gravity (Celebrate Black History Month) + Aerospace development in Africa

2. A brief discussion on Quantum Computation and Quantum Supremacy (kick-off for the AIAA LA-LV Quantum (Aerospace) Program/Events)  
(Continued from Page 13)

Mr. Stuart Marongwe showing the rapidly developing aerospace activities and education in Africa. (Left: Student Rocket Teams; (middle): African countries with aerospace activities/agencies; (right) Introduction slide showing Botswana next to the norther border of South Africa.

Dr. Ken Lui showing the history of the Black History Month (left), the Rogers Commission for Space Shuttle Challenger Investigation in 1986 with Neil Armstrong and Richard Feynman (middle), and Feynman’s lecture on the Nature’s Law and Quantum Mechanics, which is the basis of Quantum Computers and Quantum Computation.

Dr. Ken Lui explaining the beginning of Quantum Mechanics and & 3 Quantum Revolutions (left), debunking the myths of quantum teleportation (middle), and the basis of quantum computers, the qubits (right).
Chesley Bonestell and His Great Lunar Mural (Continued from Page 15)

The fate of his mural was now sealed. A year after the Apollo 11 Moon landing, the Museum of Science decided that A Lunar Landscape had to come down. In 1976, it was sent to the Smithsonian and put into storage. In July 2005, the mural, still in one piece, was carefully unrolled for archival inspection. Space artist and Co-Producer Ron Miller was on hand that day and remembers, “It was in pretty bad shape. Areas of the painting showed blooming and there were a lot of cracks in the surface that were created when it was taken down. It was obviously in need of restoration.” With no funding available for conservation work at that time, the mural was carefully rolled up again and back it went into storage. Would people ever see this painting again on display?

Everyone on the Chesley Bonestell film team was excited to learn of this terrific news about the mural. Both Co-Producers Ron Miller and Melvin Schuetz have often said, “Chesley’s vision of the lunar surface may be inaccurate but he painted the Moon the way it should have looked!” For a further perspective on this subject, click on the picture below to read a fascinating article by Dr. Tom Crouch:

of lunar exploration, with emphasis on one of the greatest achievements in human history: America’s Apollo program. The restored mural will be installed later in 2021, with the gallery opening roughly a year after that. “We’re very pleased to be putting this huge and historic Bonestell masterpiece back on display after being out of public view for over fifty years,” Dr. Neufeld said. You can learn more about Destination Moon in an article written for the February/March 2021 issue of Air & Space Magazine by Dr. Neufeld, who is also lead curator of the Destination Moon gallery. Just click on the image below:
Chesley Bonestell and His Great Lunar Mural
(Continued from the Previous Page)

You can also see an excerpt from Chesley Bonestell: A Brush With The Future that explores the story of A Lunar Landscape by clicking on the image below:

Experience the full award-winning documentary!

Special thanks to Dr. Michael J. Neufeld and the Smithsonian's National Air and Space Museum for their generous assistance with this article.

Please visit our website at www.chesleybonestell.com
Synthetic Electrofuels, with biofuels already used in test flights [10]. Biofuels are made from compostable waste and biomass, while Synthetic Electrofuels (e-fuels) are created with the use of electricity creating a liquid hydrocarbon out of CO₂ and water, acquired from human emissions activity for instance [11] Using unwanted material to create energy is promising. Biofuels and Electrofuels, the last one being considered as a Renewable Fuels of Non-Biological Origin (RFNBO), are fuels allowing them to be used in current aircraft and can be used as a complete substitute of fuel. Small powerplant system changes might have to occur to keep in consideration safety of operations, but in terms of cost, using the same aircraft with the new fuels is economically attractive. Comparing fuels on an energy density base, 100% use of Biofuels has less energy than current jet fuel [12] while Electrofuels are planning to obtain an energy density of 32 MJ/kg of fuel [13], which is slightly under the current energy density of Jet A-1 turning around 46 MJ/kg [31]. Despite the fact those solutions have a lower energy density than current jet fuel, it could help the industry reduce its environmental footprint. Research on Biofuels and Electrofuels are still ongoing, and progress is made to increase the energy density [14].

A second solution to reach the ultimate zero-emission during flight would consist in using electrical energy instead of fuel [15]. Even if electrical motors are more efficient than jet engine - a ratio of 3 - if considering a brushless motor technology, batteries energy capacity (195 Wh/kg at highest [16]) are too low compared to jet A-1 (10,000 Wh/kg [17]). Moreover, Lithium-ion batteries are made of pollutant that can’t be recycled or reused yet [18], transferring the carbon footprints on a different life cycle stage for long-range aircraft [20]. Li-Air therefore help reduce batteries footprints. A way to use electrically driven aircraft without Lithium-ion would be to use Nano-electrofuel [16] or to have a hybrid configuration. Nano-electrofuel is interesting as it is an electrically charged liquid (positively or negatively charged), used like a fuel and place in tanks separated by a membrane where the electricity will be retrieved. The liquid can be recycled and this technology is expecting to achieve an energy density of 575 Wh/kg. Hybrid configurations can be, for instance, a generation of electricity combining fuel cells and Liquid Hydrogen (LH₂) [22] or the use of a high-by-pass ratio using LH₂ as an onboard generator. LH₂ is considered as the 3rd lowest-carbon fuel according to Safran [23] as it has a rather high energy density of 120 MJ/kg [6] and emissions stay only 50 years in the atmosphere [3]. Main issues are regarding its production and bigger pressurised storages at a temperature of 20 Kelvin which is incompatible with current aircraft configuration [6].

Aircraft structure improvements

Aircrafts have been using the same single fuselage-wing shape for years as it was the ideal shape for the propulsive systems used. Now, these systems and new technologies are improving aircraft structures to reduce Drag, Weight, Powerplant and Noise, decreasing the fuel penalty and finding optimum shapes for different propulsive systems [24].

Two concepts of aircraft have a lower drag generated during flight: Box-Wing (PrandtlPlane - PP) and Blended Wing body (BWB) aircraft. Box-Wing aircraft have two superposed wings and a fuselage [25]. A Sea configuration is possible with a hybrid or LH₂ propulsive energy [27] increasing the number of commercial routes. A configuration using the Open rotor could help reduce noise and fuel consumption even more [28]. The BWB, also called a flying wing, has only a single trailing edge reducing the induced drag. The length and a wide fuselage are suitable for LH₂ circular tanks. Those configuration are more fuel efficient than a conventional commercial aircraft with the same capacities [26], reducing...
Powerplant on top of the fuselage configuration can also help decrease the noise thanks to the fuselage acting as a sound barrier.

The use of those aircraft concepts can be combined with new propulsive systems. The Open Rotor is consuming 30% less fuel than the CFM56 while reducing the noise [30]. The Open Rotor can only be used with fuel, a hybrid configuration could lead to further application of this engine in the future. LH₂ High-by-pass ratio (HBPR) are estimated to be very efficient turbofan for long range aircraft with good performances and noise reduction [31]. Distributed propulsion using several electrical ducted fans could be easily implemented at the rear of the fuselage/wing to create a boundary layer, decreasing the fuselage drag [32].

Some research can help increase aircraft performances. For instance, golf balls are using a determined geometry surface to create a turbulent boundary layer to go further [33]: this could be used to achieve a natural turbulent boundary layer on aircraft surfaces. Another example is the following: whale tails have protuberances reducing by 8% the drag and increasing the Angle of Attack by 40% [34]. Surfaces create drag, morphing wing could reduce drag without using joints [35] or as in project demon demonstrated that mobile surfaces could be avoided to control the dynamic of the aircraft [36], reducing in parallel aircraft radar signature and noise.

New airframe structures configuration in line with new powerplants and propulsion system will definitely help to build a more performant aircraft, allowing lower particles emissions and a better aerodynamics. Technologies are still being characterized, but proof of efficiency are already present.

**Systems**

In line with new airframe structures, systems in the aircraft have an important role to play in making aircraft more environmental. Depending on what propulsive energy being used, secondary power for systems will have to adapt.

Batteries are not efficient yet and studies are helping to create a More Electric Aircraft (MEA). New generation aircraft have more electrical power on-board and are equipped with electrically powered actuators powered like Electro Hydrostatic Actuator (EHA) and Electro Mechanical Actuator (EMA) which increasing the efficiency and safety of systems [37]. For example, EHA is a localised hydraulic circuit. The power needed to keep the pressure at the required level for actuation is lower as hydraulic losses are less to happen.

MEA could also help use the OLED screens [38] and replace traditional windows and cockpit. Fake windows will allow a smoother structure, reducing drag and weight created because of structure reinforcement around window. This technology offers a low electrical consumption while being lightweight, but concerns should be made on the reliability of this technology and human trust and comfort in aircraft if this technology were to be used.

E-taxi and regenerative landing gear is interesting as the fuels to move the aircraft on the ground are energy-consuming, why not use aircraft inertia at landing to recharge batteries and reverse this energy to perform aircraft taxi [39]. Being an interesting concept, complexity of this technology will add weight to the structures combined to poor batteries efficiency to stock the energy produced and could increase fuel consumption instead.

An alternative of e-taxi could be to remove landing gear systems and assist the take-off and landing of aircraft with a maglev electromagnetic rail (Project ‘Gabriel’). Removing landing gears weight, this concept can reduce aircraft weight by 9.3% and fuel consumption by 18.1%, as well as reducing the noise during take-off up to 64% [40].

Systems are being designed and are focusing on electrically powered system. Systems will change the way of how people fly as well as helping reduce aircraft consumption.

**Conclusion**

A critical appraisal performed on new technologies to increase aircraft performances showed us the implication of aircraft industries to make aircraft ‘greener’. Several promising technologies and research have been made, allowing us to better understand the future of aircraft. In, new technologies were given a number between 1 and 5, with the following signification (1: Totally not suitable; 2: Feasible but not recommended; 3: Already in use; 4: Suitable, need more clarification; 5: Totally suitable).

Numbers were influenced by different parameters such as the life cycle of the Aerospace Vehicle, a military aircraft will not have the same life cycle compared to a civil aircraft, the immediate use of the new technology, does the structure need to be change, and the feasibility of a new technology if it is still in a research stage, and will be developed in the next section.

**OPERATIONAL CHANGES OF NEW AIRCRAFT**

New technologies to increase aircraft performances were established in the previous section. New aircrafts mean new ways of operating them. An aircraft life cycle can be summarised in 5 steps [41] starting from the Design, followed by the Manufacture, the Operation, the various Maintenance-Repair-Altercation to achieve Continued Operational Safety. For this challenge, we are going to have a look at the Maintenance, aircraft Operations and end of life changes resulting from new green technologies in aircraft.

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Be Green, Keep Flying! (Continued from the previous page)

### Flight Operations

In previous section, several new aircraft configurations could be adopted. Amongst them, a short range with low capacity import electrical aircraft was found to be a solution for a future aircraft. Short range aircraft are mostly affected to regional routes with a short turn times and high numbers of flight a day. A major issue encountered would be charging the batteries in a short time enough to have a relevant economic model to make companies earn money. Fast charging of batteries is creating heat and can damage the cells if not performed right while increasing the weight to withstand the heat generated by using this methodology. In CS 25, section 1353 ‘Electrical equipment and installations’ [42], it is stated that batteries temperature and pressure need to be the same at any time when used. More easily controlled in the air with ram air cooling, it is more challenging on the ground. An external cooling system will need to be found in order not to increase the weight of the aircraft during flight. Nevertheless, nanoelectrofuel could get rid of this issue by loading two types of fluid, 1 electrically positive and 1 electrically negative charged fluid on the aircraft as a traditional battery.

Concerning aircraft using LH$_2$, first point should be made on the certification process. No mention of LH$_2$ in CS-25 is present, making an aircraft impossible to have an airworthiness certificate yet. Lack in CS-25 could be explained by the different issues that are still up to date. LH$_2$ are transported in a 2-bar-pressurised tank with a temperature achieving in this state 20 K (– 253°C). Moreover, it was established that to increase fuel efficiency, the inlet temperature should be around 150 K at least (-123)[6]. Despite the fact that small changes on aircraft could allow the use of LH$_2$ in aircraft, temperature and pressure are the limiting factors, increasing thermal cycle and compromising safety of operation. During refuelling or a parking overnight, what are the condition required due to the usage of LH$_2$? Tank are highly isolated, but a constant temperature would need to be achieved to limit dilatation of it that could damage the structure of the aircraft during an overnight parking.

As part of LH$_2$ tank, BWB or PP could be used with their upgraded performances. Choosing the PP configuration, if a distributed propulsion system made with ducted fan is used on the trailing edge of the wing to increase the boundary layer, a new emergency evacuation process will need to be redefined as emergency exit from the wing will not be possible.

Looking at military application and usage of new technologies to fulfil the demanding life cycle of combat and unmanned aircraft, batteries were not recommended if operational force is needed quickly, but nanoelectrofuel could still resolve this.

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Be Green, Keep Flying! (Continued from the previous page)

issue. OLED technology could be of use for combat aircraft only and if this technology is resistant enough, why not imagine a counter parallel OLED screen that could help hide aircraft from its enemy. Last but not least, E-taxi with an auto guided electrical vehicle could help save fuel for more mission flight time and also increase the time to displace aircraft if an urgent operation is needed. As military have dangerous missions, choice of propulsion should be chosen for spying or combat abilities.

Operation of flights are going to be deeply changed by new aircraft. Choose of a new technology in accordance with emission diminution policy should be chosen in accordance with safety of Operation.

Airports infrastructure changes
The aviation industry can go greener if we take into consideration all the chain that involve an aircraft. Airports are also buildings that involve various form of pollution from both aircraft and daily commuting cars. How an airport can help aviation to be more environmentally friendly?

Green airports can lead to several benefits such as an increase in biodiversity and ecosystems, improve water quality, conservation, and restoration of natural resources. Plants and microbes help to degrade chemical pollutants and organic wastes. The presence of plants attracts pollinators which provide economic benefits to the agricultural ecosystem as it can increase the productivity of food crops as well as giving a good natural environment for passengers.

Airports can help reduce aircraft particles emission and noise emission using building materials working as noise protection barriers or encourage people use public transportation. Alternative or renewable energy sources should be implemented and could also be combined with use of intelligent energy control equipment for lighting, heating walkaways, and escalators. These initiatives impose the installation at airports of wind turbines, biomass power plants and intelligent energy systems, recycling facilities, and so on. As well as other resources, Airports consume a lot of water to maintain their infrastructures operational. Installation of rainwater harvesting program, polluted water storage and treatment, water recycling and reuse, and other systems will help to save water. Recycled water is sufficient for airport operations because mainly used in non-potables activities such as floor and aircraft washing, air conditioning systems for instance. Airports using recycled water demonstrate that it is economically and technically feasible and helps the environment [43].

Waste management should also be improved. Lot of materials are used for the reconstruction of runways or by consumers. Thus, recycling can contribute to landfill pressure relief and reduces the demand for materials extraction. Use of recycled pavements could allow a rapid reopening with the material being already on the field for instance. Implementation of waste incineration will help reduce unnecessary waste such as packaging while producing energy.

Airport configuration changes should take in consideration aircraft of the future. LH2 facilities combining production and stocking would need to be added, as well as a Maglev rail for the GABRIEL concept. A Maglev rail should allow aircraft with landing gears to take-off and land as not all aircraft might use this concept. On a military side, use of GABRIEL concept might be useful on the next generation aircraft carrier of for French operational force. Electromagnetic rail can help propels aircraft with a high velocity and could allow space combat aircraft to achieve its high location more quickly with less fuel burned during flight.

The global air transport is expected to continue its rapid growth. At airport level, changes can definitely be put in place to reduce environmental, social, and economic impact and help the use of environmentally friendly aircraft.

Maintenance and end of life
Maintenance is compulsory to maintain aircraft airworthy and are highly related to the end of life as dismounting process are similar.

Recycling of aircraft will help reuse material, reducing raw material extractions impacts caused by use of chemicals and transportation. Aircraft material or products are reuse at first, recycled at second and disposed or burned at third [17]. Most valued part of the aircraft are the engines and the avionics and are mainly sell for a second use on a flying aircraft.

Previously, aircraft were constituted of 70% of Aluminium for the A330 and now tendency are with Composite with the A350 using 70% of it in its structure [17], to reduce structure weight and fuel penalties. Nowadays, 90% of the aircraft are valued during end of life but Carbon fibre are the missing part of this process. This material might save several amounts of fuel during flight, but recycling of it is not possible yet compares to Aluminium. New technologies might save energies and cost during flying, but the overall life cycle of an aircraft should be considered.

New technologies such as LH2 tanks and batteries, while considered on a maintenance phase, can be less attractive. Use of LH2 for end of life can be compared as use of Jet A-1 in a way considering that fuel when used only will left the tanks to take care off, but maintenance of them are complicated due to

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Be Green, Keep Flying! *(Continued from the previous page)*

the low temperature and pressure, and a direct eye check will not be possible to perform, therefore integrity of tanks will need to use adapted micro camera instead. Batteries are complicated to maintain and to recycle. High power in batteries are harmless to human and dismantling it need to get rid of the total stock electrical energy. Moreover, and bad maintenance could create cells malfunction leading to a potential fire.

To help reuse and recycle aircraft, aviation stakeholders launched the Process for Advanced Management of End-of-Life Aircraft (PAMELA) project including research in three stages: decommissioning, disassembly, and smart and selective dismantling. An Aircraft Fleet Recycling Association (AFRA) was co-founded by BOIENG to set-up new standards for aircraft dismantling, being responsible of 150 aircraft recycled every year.

Aircraft manufacturers are taking maintenance and end of life of aircraft seriously, showing good results and progress, and working in collaboration with ICAO Committee on Aviation Environmental Protection (CAEP) to support aircraft sustainability development.

**FLYING IN THE FUTURE, A HUMAN CHALLENGE**

Previous sections showed that technologies consistency and viability are progressing very quickly. What could precipitate the use of those technologies, what role does politics and consumer have and what will social, financial, and political impacts be?

**Immediate improvements, an economical motivation**

Major technological changes are still on progress. Despite the urgent times, several immediate improvements can be applied on current aircraft.

Improvements on electrification can be done on aircraft but also on software or onboard connected system. Development of the latter can help acquire real time information. Knowing the weather is useful for the optimization of altitude in order to use less fuel. Indeed, the optimal altitude of a plane changes along with the flight as it consumes fuel, thus its weight will decrease. Air France are working on flight road optimisation using digital information to have better precision and reliability. OpenAirlines developed a software based on data analysis from the flight recorder, meteorological data and flight plan that enable companies to save fuel. Pilots can use the software called MyFuelCoach to replay his flight in 3D and have information about the use of fuel in real time and see the different impacts when he leaves the landing gear, deploys flaps and other manoeuvres and learn how to decrease its fuel consumption. Taxiing can now be performed with one engine only.

Thales is working on a flight management system to optimize aircraft trajectories. Ironically, thanks to the support plan due to the COVID-19, research are accelerated. Pureflyt is developed to calculate in real time, new trajectories for optimization flight through a permanent exchange of data between the aircraft, the ground components, the airline, and the air traffic control transmitted by satellite constellations. For instance, if there is a storm, indication of it will appear on screen before the onboard flight radar allowing the calculator to propose an improved and more efficient new trajectory helping save fuel.

Aviation used to be a linear economy, that is to say: it takes the resources, makes the latest product, keeps it for a couple of years and then, disposes of it in landfills. The linear economy is not sustainable because it consumes a lot of finite resources and generates a significant amount of waste, pollution, and greenhouse gas emissions. Whereas, the circular economy works to reduce waste, reusing and recycling rather than wasting resources, it tries to keep materials as long as possible. The 3 main actions are known as 3R: Reduce, Reuse, Recycle and companies like Air France-KLM group started to adopt this strategy in their flight operations.

Applying the circular economy to aviation means a focus on designing and operating for sustainability, a design for reusability, a maximization in asset utilization, and better recycling. Therefore, it aims to reduce as much as it can, the environmental and social impacts, as well as to reduce economical costs and create jobs. The circular economy increases customer satisfaction by increasing a response to a sustainability challenge. This strategy can lead to a total modification of the supply chain, from product design to end-of-life management. Some breakthroughs such as 3D printer are yet helping aviation to transit toward a circular economy but there are still improvements that can be made to leave the linear economy. According to the ICAO report, 3D printing helped to reduce up to 90 percent of raw material consumption.

If we apply circular economy on airports, the easiest thing that we can do is to redesign waste management as Gatwick airport did in 2016. This led to several positives results such as reducing operation cost from saving of onsite energy and water, up to £750,000 for Gatwick. Thanks to its efforts, in 2018, this airport became the first to achieve the Carbon Trust’s Zero to Landfill certification which recognise companies that have successfully achieved zero waste to landfill.

Immediate changes mainly concern flying and operations methods. Education of aeronautical worker is the first step to reduce fuel emissions and economical saving directly come out from this state of mind. *(Continued on the next page)*
Be Green, Keep Flying! (Continued from the previous page)

Keep flying, social and political choices

More and more, human environmental consciousness is rising. Despite the fact that global warming was already known in 1970s, real actions are recent. Sustainability is now a state of mind, a way of leaving and a political direction.

The aeronautic domain is facing what can be called as ‘aeronautic shaming’. A radical approach would definitely be to not travel or buy products from others country, but attractivity in trips and exotic items are high. Some companies started to propose an additional green increased price to compensate the flight particles emissions. It was proven that consumer are ready to pay an extra price, but willingness is a factor of gender, flight range and gas reductions [45]. Women were more willing to pay than men. The higher the gas reductions were, the more likely the consumers were to pay this extra price with a limit of 15% the initial ticket price. Willingness to pay an increased ticket price to reduce gas emissions is encouraging as it will help compensate the high cost of a sustainable aircraft.

Consumers have a high power to make things change if united, but political have the same power too on a different scale. Political collaboration is the key to the future. Starting on a local scale in France, usage of Nuclear energy to produce electricity can help perform the energy revolution to a more efficient way of energy production as the International Thermonuclear Experimental Reactor (ITER) is trying to prove. Nuclear energy is creating debate as thought unsecure and radioactive, but this technology is not creating huge amount of CO₂ during energy production. The Fessenheim Nuclear power station was set out of service in 2020, results of this was the increase of imported electrical energy produced through coal-fired power station. ITER will be tested in 2035 and low CO₂ emission and constant energy will start in 2100 [46].

Changing scale and moving to the Europe Union (EU), Airbus was created to concurrence Boeing. Several countries are working together daily, and Airbus proved more than once its capacity of achieving a good product from several collaborations. Batteries were found to be very low efficient and not that much useful for future aircraft, but a political call was made to create the ‘Airbus of batteries’. This collaboration will make several countries works on batteries and hope would be that an efficient, sustainable, and moral [47] battery is created. The world needs batteries, but moral and pollution coming from them should not be part of making a better future world.

Improvements can be made in the EU also by merging airspace. EU planned to reform Air Traffic Management (ATM) because of the growing traffic. The de-fragmenting of Europe airspace will increase safety, reduce the aviation environmental footprint, and reduce costs related to service provision. Indeed, today, due to inefficiencies in European ATM, companies are facing unnecessary delays and aircraft are producing more CO₂ emissions than they should. This project is named Single European Sky (SES) and was launched in 2000 by the European Commission. Thanks to this initiative, companies can plan freely their flight path, allowing more direct routes, saving cost, and reducing CO₂ emissions. SES concerns civil aviation, but military organizations demonstrated their interest in it because it will enable them to have a better access to European airspace for training and operational purposes without major constraints. It represents 25% [48] of all flights operating in European airspace.

EU has the power to act and define new rules in accordance with a sustainable world policy, but concerns should be made on worldwide political stability. In 2016, the Brexit was pronounced. Now the pandemic is striking the world and how countries are dealing with the pandemic shows the different policy of different countries. Collaboration are important to combine and share knowledges, but economic and politic interest, if not human and sustainable centred, could create damaging issues for the good of operations. Gross Domestic Product (GDP) gross is one of the major objectives to have jobs and a good country economy, but Jancovici [8] proved that diminution of resources is not compatible with GDP growth. Decision to maintain stability in countries will definitely come from energy independency. Production of new energies such as Biofuel or Synthetic fuel for instance will definitely come from energy independency. Production of new energies such as Biofuel or Synthetic fuel for instance will need more biomass or electricity input. Biomass can be increased with additional farming on another country soil, but choice of the country to feed its people or to increase its economy will then create moral issues.

Flying was created by and for human being. The world is answering to a well-known economical scheme, interests first. Consumers proved that they are ready to help in performing the sustainable transition and should be supported or outdistance by politics, keeping moral integrity and human dignity while doing it.

Future of transportation

In this document, information was mainly concerning the aeronautic sector. In fact, future of transportation can be split between air, road, or marine transports.

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Be Green, Keep Flying! (Continued from the previous page)

Electrical Vertical Take-Off and Landing (e-VTOL) aircraft are considered as the new urban way of transportation in cities [49]. Ducted fans or propellers e-VTOL aircraft are favoured in urban mobility because structure footprints are rather small as it does not need a specialized equipment for take-off and landing. We just have to put the ducted fan on the ground, and it takes off vertically. Electricity is easy to install allowing the use of electric engine, lowering the noise which is a must if we want to use e-VTOL in urban areas without disturbing people. UBER plans to develop an urban air taxi network using e-VTOL to transport people from one place to another by a ride-sharing system. They aim to create a quiet, fast, clean, efficient, and safe transportation system that is affordable for all [50].

The issue that they meet is again the low energy density of lithium-batteries which held up long distances flight. Different actors from different sectors: aerospace companies (i.e. Airbus, Boeing, …), automotive companies (i.e. Audi, Honda, Toyota, …) and technology leaders and investors (i.e. Google, Intel, Uber, …) are developing high performance lightweight batteries and hybrid-electric systems. Such an implication of some world’s largest companies shows that the e-VTOL might be the future of aviation and transportation. During the COVID-19 pandemic, Air Force was deployed to transport a patient from a hospital to another, we saw the importance of aviation in daily life. The use of e-VTOL might be very useful and convenient. E-VTOL can be a promising technology for future aviation if it can pass through technological and regulation challenges standing in his way.

E-VTOL can replace cars and what can replace trains and short-range flights? The hyperloop, a project initially imagined by Elon Musk might be a response to this question. This concept relies on magnetic levitation pods, propelled at speeds of up to 760 miles per hour [51] in a low pressure tube. With this speed, it can connect major cities rapidly. This new way of transportation can help to reduce congestion in airports and is more environmentally friendly with its low energy consumption. Furthermore, it will use solar energy using photovoltaic panels placed on the tube and batteries will be recharged during the braking of the train. Thanks to the high speed, hyperloop can glide using passive maglev energy and will use only 10% of energy to initiate final velocity in the whole path. If hyperloop has a lower impact on climate change, it can have a negative effect on socioeconomic. Indeed, hyperloop especially plans to connect two main cities together. People living far from the station will not really be involved in by this new technology, whereas, they will contribute to the network through taxes. In addition, they will not benefit from the influence of the Hyperloop network, places where can attract more business and tourism.

Hyperloop can be useful to transport passengers from one place to another but for products, airship can be a good substitute too. Airship does not have a good image in our mind because of the Hindenburg accident in 1937 due to hydrogen leak but today, new technologies can help to avoid this problem such as the use of very resistant materials. Airship does not require polluting energy for the elevation because it uses helium or hydrogen, fuel is used only to propel the ship forward. Thus, this way of flying will generate only 10% [52] of the CO2 emissions of a commercial aircraft. It can be used in the case where helicopters or ships could not land because of earthquakes for instance as airship can land even in an unstable land and without specific infrastructure. The comeback of airship might be a good thing for the economy as it is a cheaper and cleaner transport than plane or boat.

After the return of the very slow heavier than air, the return of supersonic can rekindle the flames of all aviation lovers. Boom, an American start-up company is trying to create a greener supersonic. In terms of energy, they plan to use alternative fuels to lower their impact on climate change, tests were handled in 2019 and results show a positive way for this energy. Noise is the big concern for a supersonic aircraft and they also have to reduce the sound of the boom when they exceed the speed of sound which can be reduced if they adopt an optimal shape for the aircraft. It can be a promising technology because some companies such as Virgin Group or Japan airlines have already invested in this project [55]. Boom affirms that they can reduce the cost of supersonic flights by 75% [55] so the price of the ticket will be equivalent to a business class ticket.

CONCLUSION

Global warming and its accelerated evolution are concerning issues and aeronautic stakeholders are definitely involved and actively participating in developing sustainable aircraft shown with several technologies and research to achieve this goal. New propulsive energy and new structures might take over traditional aircraft in a near future.

It was found that depending on the operations, propulsive energy and propulsion systems would have different applications (cf. table 2). Propulsive energy was found to be the most complicated issues in terms of technology, energy production and density in general being low to compensate Jet A-1. Using renewable energy and oil substitute are not enough for worldwide transportation demand, energy will be more expensive increasing economic and social split. Economy priority will allow rich people to fly in supersonic business aircraft while average human would stop fast travels.

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Political stability, consumer passion and worldwide partnerships are a way to help this transition to lower particle’s emissions. Clear and Transparent knowledge sharing in collaborations will allow further progress. Global warming and energy production should be the next priority if we want to keep human travelling. Note that runways for aircraft have a lower impact in terms of carbon footprint than the other transport as they need roads or rails to circulate.

Supposing an optimistic approach with ITER technology working in 2100 in the world with sustainable batteries acquired from the ‘Airbus of Batteries’, transportation will face lack of fuel until 2100, decreasing common transportation system and digging social inequalities while using the existing energy, the transport sector will live again in 2100 with more hydrogen and electrical vehicles summarised in Table 3.

<table>
<thead>
<tr>
<th>Transports</th>
<th>2030</th>
<th>2050</th>
<th>2065</th>
<th>2100</th>
<th>Application</th>
<th>Freight</th>
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<td>High Speed Train</td>
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<td>↑</td>
<td>5.15</td>
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<td>0.06</td>
<td>High Income</td>
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Table 3: Estimation of different transport (in EU) use function of energy progress (graph in appendix)

References
Be Green, Keep Flying! (Continued from the previous page)


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When you think of the Apollo 15 mission and reading the depth of command module pilot Astronaut Al Worden poetry, one can understand the emotions of someone who has vast experience in deep space.

The author Al Worden with Francis French, and illustrator Michelle Rouch together created the children’s book, “Astronaut Al Travels to the Moon.” The author spent time looking for an illustrator and Michelle Rouch was happy to accept the challenge. The spark of the project all started during a fundraising event for Time in Cosmology, led by Czarina Salido who featured guitarist Gabriel Ayala, space artists Simon Kregar and Michelle Rouch with Emcee Geoff Notkin on March 6, 2018. At the end of the event while Michelle Rouch was tearing down her art display, Francis French had mentioned that Al Worden is looking for an illustrator for his children’s book, and the rest is history. The hardest part of the project was finding a publisher. The project continued with closed loop communication between Al Worden, Francis French and Michelle Rouch with the request in creating 13 unique illustrations that depicted the essence of the poem. A publisher was secured in mid-2020 and released the book on March 15, 2021 during CiLive in Des Moines, Iowa.

Children’s books have a profound effect on society. The unique perspective of Al Worden’s experience along with the colorful illustrations hopes to influence kids at an early age to consider a career path in the technical and scientific fields.

More details of "Astronaut Al Travels to the Moon" are available at www.astronautal.com and the illustrations can be viewed at rouch.com.

**About the Illustrator:** Michelle Rouch grew up in Dayton, OH and the strong aerospace history influenced her future. But it was her brother that influenced her to become an engineer, like him. Michelle Rouch is now a Senior Engineer with over 30 years of experience working for DoD, and serves as technical advisor for major weapon systems produced at Raytheon, covering product lines for all branches of the military. She is the Chair for AIAA Tucson-Section, member of SAT IOC, and recently earned her AIAA Associate Fellowship. Michelle Rouch is also a self-taught artist with over 40 years of experience. She continues to aim high to revolutionize the technical world with a contemporary artistic touch. She wants to capture the emotions of people living and thriving in an aerospace world on Earth and beyond, and create more illustrations for children’s books.
AIAA Member Spotlight on Ms. Michelle Rouch

(Continued from the Previous Page)
RSVP and Information: [https://conta.cc/3e0r1Bh](https://conta.cc/3e0r1Bh)

Saturday, March 27, 2021, 10 AM PDT (GMT-0700) (Add to Calendar)

**The 3rd AIAA LA-LV International Space Architecture Gathering 3/27**

Space Architects are involved in proposing visions and a variety of concepts for habitation in extreme environments that include human space activity, especially for near term missions. Preintegrated, deployable, erectable and hybrid structures that use local resources are sought. Visions range from habitats in Earth Orbit, on the Moon, Mars and in cislunar space.

Here on Earth, several simulations have provided insight into crew needs and behavior and many more are planned or in various stages of development. Out of these missions, exercises and proposals are also born energy and resource conscious designs for immediate applications on Earth, in specialized facilities and in our smart cities, and dwellings.

This international gathering of space architects will present some visions and projects being contemplated for both space and Earth applications.

Event will conclude with a panel discussion.

**Tentative Agenda Space Architecture Gathering for Saturday March 27th, 2021**

(Not: Pacific Daylight Time—PDT (GMT-0700))

Let us go from Earth orbit to Moon to Mars and then Simulators!

10:00 AM PDT – Welcome (Dr. Dan Dumbacher, AIAA Executive Director)

10:15 AM PDT: Prof. Madhu Thangavelu (USC) (Moderator, Welcome, Keynote)

10:30 AM PDT: Prof. Sandra Haeuplik-Meusburger - Space Habitats and Habitability, Vienna University of Technology, Austria

10:45 AM PDT: Mr. Vittorio Netti - Human-Robot Collaboration as an Enabler of Scalable Human Presence in Space, SICSA and Politecnico di Milano, Italy

11:00 AM PDT: Prof. Behrokh (Berok) Khoshnevis - Planetary Construction and In-Space Fabrication using Large-Scale 3D printing, Contour Crafting Corporation, CA

11:15 AM PDT: Mr. John Mankins - (TBD), Mankins Space Technology, Inc.

11:30 AM PDT: Ms. R.Pailes-Friedman, Mr. M.Morris, and Ms. Christina Ciardullo - Lunar Lantern & Landing Pad, SEARCH Architects

11:45 AM PDT: Mr. Rodrigo Romo, Basalt Sintering for ISRU

12:00 PM PDT: Mr. Daniel Inocente, Advancing Architecture, Integrated Tectonics, Senior Designer, Skidmore, Owings & Merrill, New York

12:15 PM PDT: Mr. Giuseppe Calabrese, Urban farming for extreme environment on Mars, Sydney, Australia

12:30 PM PDT: Mr. Jim Rhoné, Building Bioregenerative Worlds, Interstellar Lab, Paris


1:00 PM PDT: Mr. Philip Sadler, Lunar/Mars Greenhouse, Sadler Machine Co. & University of Arizona

1:15 PM PDT: Ms. Mirha Vlahovljak, HiveMars: Design of a Hybrid-class, scalable Settlement on the Martian Surface, Polytechnic University of Bari, Italy

1:30 PM PDT: Prof. Michael Fox, A Brief Overview of the CPP NASA X-Hab, CalPoly Pomona, CA

1:45 PM PDT: Mr. Xavier de Kestelier, The Value of Design: Mars Habitat, Haskell Architects, FL

2:00 PM PDT: Mr. Sebastian Frederiksen, LUNARK - 100 days Lunar analog in an unfolding habitat in the arctic, SAGA Space Architects, Denmark

2:15 PM PDT: Prof. Pablo de Leon, Planetary Habitat Analogs at the University of North Dakota, University of North Dakota

2:30 PM PDT: Mr. Kriss J. Kennedy, Architect. A Vision of the Future: Built-in-Place Architectures, USS, Inc / TECHNE’ Architects LLC., Houston

2:45 PM PDT: Discussion

3:00 PM PDT: Adjourn

Questions about Events/Program: events.aiaalalv@gmail.com

Disclaimer: The views of the speakers do not represent the view of AIAA or the AIAA Los Angeles-Las Vegas Section.
RSVP and Information: https://conta.cc/2P4jfvq
Saturday, April 3, 2021, 10 AM PDT (GMT-0700) (Add to Calendar)

**LGBTQ and GSM in Aerospace**
by
**Mr. Sean Mobley**

Podcast host and the volunteer coordinator at the Museum of Flight in Seattle

Throughout the history of aviation, from Leonardo Da Vinci to Major Margaret Witt, LGBTQ people have designed and flown aircraft, pursued the dream of space flight and risked their lives for their country. In this exciting talk, Sean Mobley, podcast host and the volunteer coordinator at the Museum of Flight in Seattle, shares the histories of some key LGBTQ pioneers in aerospace history. He also discusses figures in the aerospace industry who have worked to advance the cause of LGBTQ equality.

Tentative Agenda (All Time PDT, Pacific Daylight-Saving Time, US and Canada)
10:05 AM PDT: Welcome
10:10 AM PDT: Mr. Sean Mobley
11:40 AM PDT: Adjourn or a 2nd talk/topic

Questions about Events/Program: events.aiaalalv@gmail.com

Disclaimer: The views of the speakers do not represent the view of AIAA or the AIAA Los Angeles-Las Vegas Section.
RSVP and Information: [https://conta.cc/3tHV5a4](https://conta.cc/3tHV5a4)

Saturday, April 10, 2021, **10 AM PDT** (GMT-0700) ([Add to Calendar](https://conta.cc/3tHV5a4))

**AIAA LA-LV Special:**

*In Honor of the 40th Anniversary of the First Flight of the Space Shuttle:*

*The Outward Odyssey Authors Present "Columbia and the Legacy of the Space Shuttle Program."*

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Mr. Geoffrey Bowman  
Mr. Colin Burgess  
Mr. Jay Chladek  
Mr. Melvin Croft  
Ms. Michelle Evans

Mr. Francis French  
Mr. Chris Gainor  
Mr. Jay Gallentine  
Mr. David Hitt (Moderator)

Questions about Events/Program: events.aiaalalv@gmail.com

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engage.aiaa.org/losangeles-lasvegas
RSVP and Information: [https://conta.cc/3flPYrx](https://conta.cc/3flPYrx)

**Thursday, April 15, 2021, 9 AM PDT (GMT-0700)** ([Add to Calendar](#))

**AIAA LA-LV Special:**

**Practical Quantum Computing with D-Wave**

**Dr. Victoria Horan Goliber**

Senior Technical Analyst

D-Wave Systems

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Dr. Victoria Horan Goliber, Senior Technical Analyst, joined the sales team at D-Wave Systems in 2018. In her current role, Dr. Goliber works with teams around the world to bring quantum annealing to a variety of groups through seminars, workshops, and conferences. She received her Ph.D. in discrete mathematics from Arizona State University in 2012 through the U.S. Department of Defense Science, Mathematics, and Research for Transformation (SMART) Scholarship Program, and more recently completed a MS degree in computer science with a specialization in machine learning through Georgia Tech University. Her doctoral research bridged both mathematics and computer science with a focus on de Bruijn sequences and Gray codes for combinatorial objects. After graduating, Dr. Goliber worked as a Senior Mathematician with the U.S. Air Force Research Laboratory’s Information Directorate, along with a special assignment as the Executive Officer to the Director. In early 2018, she joined D-Wave Systems as a Research Scientist and continues to support the sales team through customer interaction and training.

**Quantum computing has moved from the research lab to the enterprise.** Hear from our expert speaker to learn about quantum computers, the kinds of applications that are best suited to today’s technology, and an overview of the programming model and tools available for D-Wave’s quantum computer.

**About D-Wave Systems Inc.:** D-Wave is the leader in the development and delivery of quantum computing systems, software and services and is the world’s first commercial supplier of quantum computers. Our mission is to unlock the power of quantum computing for the world. We do this by delivering customer value with practical quantum applications for problems as diverse as logistics, artificial intelligence, materials sciences, drug discovery, cybersecurity, fault detection, and financial modeling. D-Wave’s systems are being used by some of the world’s most advanced organizations, including NEC, Volkswagen, DENSO, Lockheed Martin, USC, and Los Alamos National Laboratory. With headquarters near Vancouver, Canada, D-Wave’s US operations are based in Palo Alto, CA and Bellevue, WA. D-Wave has a blue-chip investor base including PSP Investments, Goldman Sachs, BDC Capital, NEC Corp., and In-Q-Tel. For more information, visit: www.dwavesys.com.

Questions about Events/Program: events.aiaalalv@gmail.com

*Disclaimer: The views of the speakers do not represent the view of AIAA or the AIAA Los Angeles-Las Vegas Section.*