

# AIAA-NCS Volunteer Judges Choose the Area's Best Aerospace-Related Science Fair Projects

Editors: Susan Bardenhagen (AIAA-NCS Educator Associate), and Nils Jespersen (The Aerospace Corporation)

From March 7<sup>th</sup> to March 28<sup>th</sup>, 2015, eight teams of judges - members of the American Institute of Aeronautics and Astronautics (AIAA) National Capital Section (NCS), examined and sorted hundreds of projects at regional STEM/Science & Engineering Fairs, interviewed students from grades 8-12, and awarded honors to the top performers. In addition to the Washington, DC STEM Fair, three were held in Maryland (MD), and four in Northern Virginia (NoVA). Although the bulk of the entries were individual projects, five winning projects came from teams of two or three students. In the team entries, it was evident that all members equally shared in developing, and understanding, the technology involved. In all cases, the students showed clear grasp of their work, and provided well-prepared presentations.

Thanks to the generous support from our Corporate and Individual sponsors – **ERT, Inc., Honeywell International, Lockheed Martin, Northrop Grumman, Orbital Sciences, Science Systems and Applications, Inc., and SpaceX** – it was possible for AIAA to provide coverage to all of the areas fairs, and it also enabled us to award prizes to the student winners (first, second and third place). These winners were invited to attend the May 20, 2015 awards banquet to share their projects and receive their awards. In addition, the first place award winners received a complimentary AIAA student membership.

Again, this year, **NASA Goddard Space Flight Center (GSFC)**, through the enthusiastic support of GSFC Director **Mr. Chris Scolese**, has graciously offered to host our winners for a 3-day experiential learning visit, July 7-9, 2015, at the Center's facilities, and laboratories in Greenbelt, MD. As part of this experience the awardees will have a field trip to Wallops Island and get a tour of Virginia's premier launch facility. Additionally, awardees will lunch with an

astronaut, engage with a Nobel Laureate, and explore the Mission Lifecycle through active participation in the same critical phases used by NASA. This very special program was realized owing to the creative efforts of Dr. Supriya Banerjee (AIAA-NCS Chair, AIAA Associate Fellow), in discussion with Mr. Chris Scolese and Dr. Robert Gabrys (both of GSFC), with the able assistance of Dr. Natalia Sizov (AIAA-NCS Lead Science Fair Coordinator) and Mr. M. Bruce Milam (AIAA Associate Fellow and past NCS Chair).

## Northern Virginia Regional Science and Engineering Fair

The NoVA Science Fair was held at Wakefield High School, in Arlington, on March 7, 2015. The AIAA-NCS judging team consisted of: Josh Powers (O3b Networks), Dr. Nils Jespersen (Aerospace Corp.), and Dr. John Retelle (DARPA/Strategic Engineering Solutions LLC).



**The NoVA Science Fair Judging Team (l to r): Josh Powers, Dr. John Retelle, and Dr. Nils Jespersen**

The judging team reviewed the project abstracts and divided up the entries. They then did one-on-

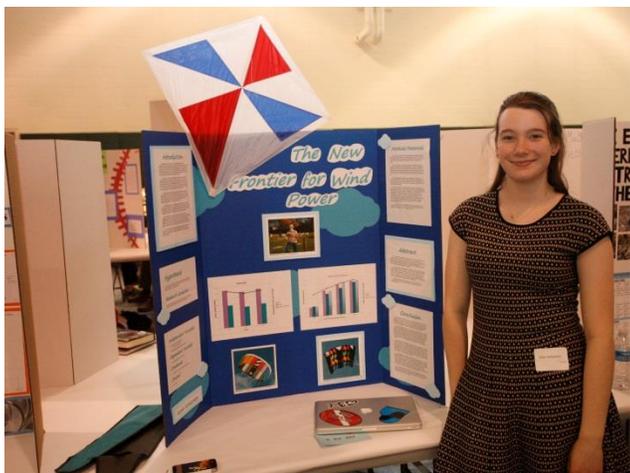
one interviews of the students followed by a consensus meeting to select the top projects. The team then did a group interview of these top projects to confirm the selection.



The Display Hall at the NoVA Science Fair, Wakefield High School, Arlington, VA

The judging team decided on the following projects for special recognition:

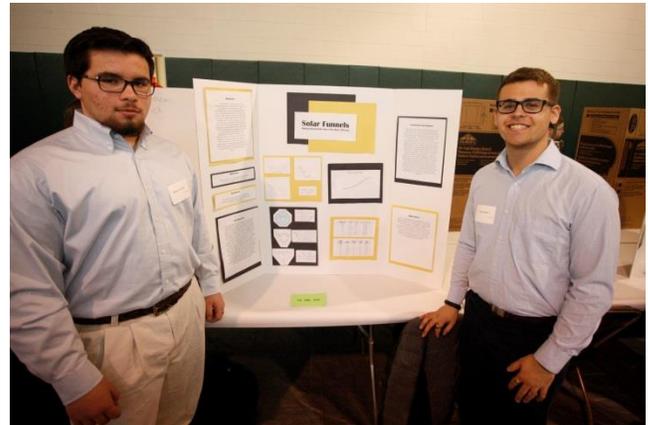
### ***First Place: “The New Frontier for Wind Power”***



For First Place, the judges chose **Katie Schlachter**, a 9<sup>th</sup> grader from Wakefield High School. Katie entered her project, “The New Frontier for Wind Power” in the Environmental Science category. Katie comes from a family of kite flying enthusiasts and, during these outings, she pondered whether the winds keeping her kite aloft could be harnessed and tapped for energy. Katie came up with an innovative turbine/mounting structure arrangement, included a voltmeter (for measuring turbine output) and an anemometer, and attached this assembly to two different kites. One kite flew in a stationary configuration, while the other was optimized for stunts. She found that flying the turbine in a

dynamic figure-8 pattern provided twice the output of that available from the static arrangement. Katie showed tremendous enthusiasm and demonstrated good knowledge of the underlying physical principles. She was also able to articulate scalability concepts, and had thought through how operation and performance might be improved, for instance, by flying the kite/turbine from a tall building in order to reach more consistent wind speeds.

### ***Second Place: “Solar Funnels”***



The 12<sup>th</sup> grade team of **Noah Hayne and Wilbur Velarde**, from George Mason High School, earned the Second Place award. Noah and Wilbur were motivated by the economics of getting more power from a solar cell without increasing the collection surface area of the cell itself. At first they used a magnifying lens to concentrate solar energy onto a small solar cell, but quickly realized that they would need a larger aperture, which would mean a large, expensive lens. Serendipitously, they found that a paper tube in front of the lens increased the output of the solar cell. From this idea, they developed an impressive geometric analysis to define an experiment that determined the optimum angle for a reflective solar concentrator around a solar cell. Noah and Wilbur were deliberate and methodical in their approach. In their presentation, they were articulate and balanced well off one another in presenting their work.

### ***Third Place: “Microbial Fuel Cells Powered by Anaerobic Solutions”***



**Cory Dudka**, a 9<sup>th</sup> grade student from Washington-Lee High School, received the Third Place award. He entered his project, “Microbial Fuel Cells Powered by Anaerobic Solutions”, in the Microbiology category. Cory had determined that a particular bacterium in human wastewater (i.e. sewerage) has the potential of generating a significant quantity of excess electrons in the digestion process. He built an innovative, simple fuel cell from PVC piping stock, but then ran into an issue when his local wastewater treatment plant did not want to give him samples of the wastewater, citing concerns about dangerous pathogens. Consequently, Cory, instead, applied a selection of septic tank treatment products which contain various proprietary formulations of bacteria. Because the bacteria were unknown, the results of his fuel cell experiment showed significant statistical variation. Despite this setback, Cory showed a good understanding of the underlying principles, and was able to postulate how this idea could be used to supply energy during human interplanetary travel. Cory expressed a desire to become an aerospace engineer.

### **Montgomery County Science Fair**

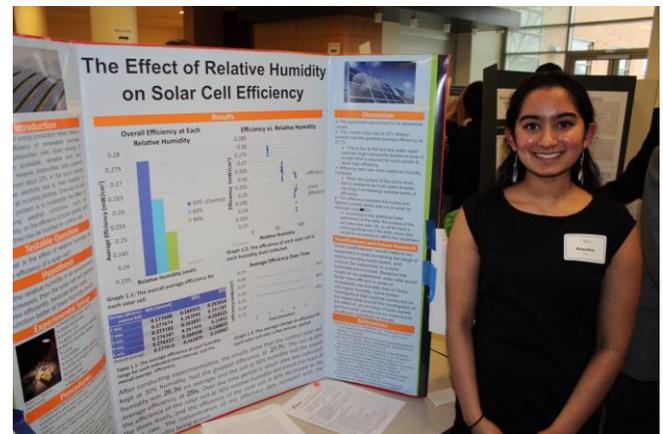
The 59<sup>th</sup> annual Montgomery County (Maryland) Science Fair was held on Saturday, March 14, 2015 at the White Oak Campus of the Food and Drug Administration. Four AIAA-NCS volunteers represented the AIAA as special awards judges in the Senior Division: Margaret Shaw (Lockheed Martin), Michael Martin (AAAS/Department of

Energy), Thomas Noyes (Graduate Student-Department of Aerospace Engineering, University of Maryland; Director of Business Development-NextBus, Inc., a division of Cubic Corporation), and Daniel Oropeza (Lockheed Martin).

There were a total of 65 projects across all disciplines in the Senior Division. Based on a review during the morning of the fair and the pre-fair information listing of aerospace-related projects, nine projects were chosen for further scrutiny. After conducting interviews with those nine the team decided on their awards.

There were several projects either directly related with aerospace engineering or involving problems whose solutions would further the field of the aerospace sciences. The judges ultimately chose four projects that were deemed the best well done and are summarized below. The judges were not able to settle on just one winner for the 3rd place prize as both projects chosen were equally worthy of the award. The judges were very impressed with the level of expertise that each of these students showed in writing computer code for these experiments. The selected projects involved coding with MATLAB, ROBOTC, JAVA, and Arduino IDE.

### ***First Place: “The Effect of Relative Humidity on Solar Cell Efficiency”***



**Anusha Dixit**, from Poolesville High School, entered her project in the Physics category, in which she was awarded Honorable Mention. She developed this project as an extension of a project that she did last year where she studied the effects of temperature on solar cell efficiency. In this year’s project, she investigated how various humidity levels affect the energy output of solar

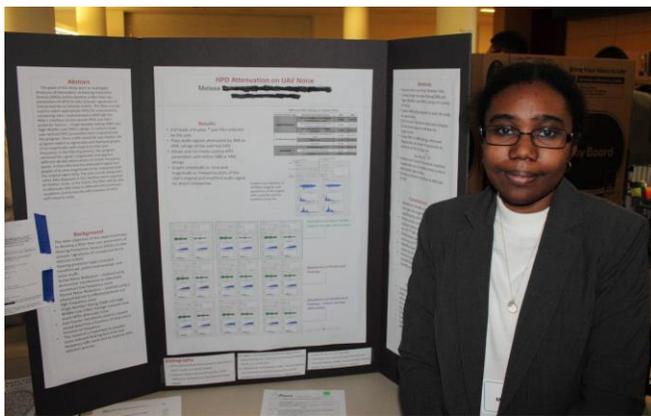
cells. She is enthusiastic about this topic and understands how to propose new hypotheses and follow-on work based on her own findings.

Anusha is interested in exploring methods to increase the performance of solar cells so that they may better provide energy in developing countries. She specifically focused on the effects of humidity because countries in the developing world experience a range of weather events. She wanted to explore how that variability in weather conditions would affect the energy output of solar cells.

The judges were impressed by Anusha's Arduino IDE coding abilities and her sound scientific methodologies. She displayed a solid understanding of her research process and proposed good ideas for follow-on work. Anusha is interested in pursuing studies in the physics or chemistry fields.

Anusha received numerous accolades from other organizations, including Honorable Mention and Invitation to Participate in the Aerospace Corporation Herndon Science Event, ASU Walter Sustainability Solution Initiatives Senior Certificate and Nomination to enter the Grand Prize for the Sustainability Solutions Festival in Arizona, the Senior Award from Clean Air Partners, a Senior Certificate and Nomination to compete in the SUNY Oswego GENIUS OLYMPIAD, and I-SWEEP Environmental Sustainability & Innovation Participation Packet.

### ***Second Place: "Effects of Hearing Protection Device Attenuation on UAV Audio Signatures"***



**Melissa Bezandry**, from Montgomery Blair High School, chose the Engineering category for her

project in which she was awarded Honorable Mention by the Fair's category judges. She investigated how well various commercially available hearing protection devices (HPDs) attenuated the noise produced by UAVs.

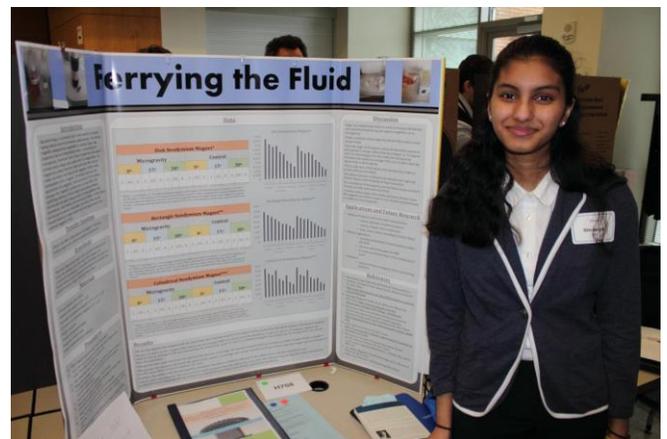
Her project is particularly impressive because she displayed a mastery of MATLAB that very few engineering college students possess. Melissa coded her own, very well designed GUI to help speed up the data analyzing process. She made use of Fast Fourier Transforms and inverse Fast Fourier Transforms to analyze the frequency spectra of audio samples collected after passing through the HPDs.

Melissa collected the audio samples herself by visiting an Air Force base and recording the sounds of operating UAVs. She was highly motivated and enthusiastic about her research and this project was clearly one of the most impressive at this science fair.

Her scientific method was particularly sound and the judges were impressed by her abilities to do all of the various aspects (MATLAB coding, understanding of FFT and inverse FFT, and sound data collection) completely on her own.

Melissa wants to pursue studies in the Electrical Engineering field. Other organizations have recognized her accomplishments in that she also received a First Place award from the American Industrial Hygiene Association and an Honorable Mention from the Air Force.

### ***Third Place (tie): "Ferrying the Fluid"***



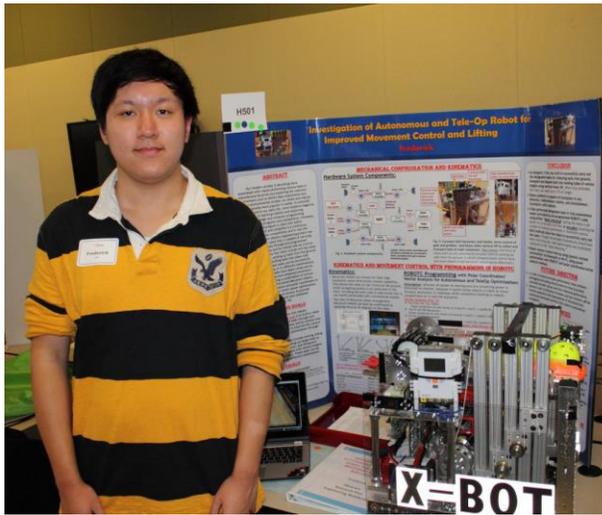
**Shraeya Madhu**, also of Poolesville High School, entered her project in the Physics category. She received Honorable Mention in this category, and

the American Society of Mechanical Engineers awarded Shraeya a Second Place award. She investigated the movement of ferrofluids due to external magnetic fields in simulated micro-gravity environments.

Shraeya used a novel experimental setup where she placed a capsule of ferrofluid in a bottle containing a sucrose solution. She varied the concentration of sucrose so that the capsule became neutrally buoyant. She then used a permanent magnet attached to a robot arm to move the capsule through the solution. She measured how quickly the magnet was able to move the capsule through the solution.

Shraeya described several applications for the research of ferrofluids, including spacesuit healing and medical applications involving the precise targeting of medications in certain areas of the human body. She displayed impressive coding skills with her use of JAVA programming for the robotic arm. She had sound scientific methods and a good understanding of the statistics behind her data.

***Third Place (tie): “Investigation of Autonomous Tele-Op Robot for Improved Movement Control and Lifting”***



**Frederick Xu** attends Richard Montgomery High School. His project was entered in the Engineering category in which he garnered Third Place from the Fair. He designed and built a semi-autonomous robot that collected various sized balls and placed them in receptacles. The most striking aspect of his project is the great complexity of his robot.

Frederick displayed an abundance of knowledge regarding the mechanics and electronics of his self-produced design. He also created an impressive video demonstration of his robot in action. He performed all of the programming in ROBOTC himself instead of using routines created by others.

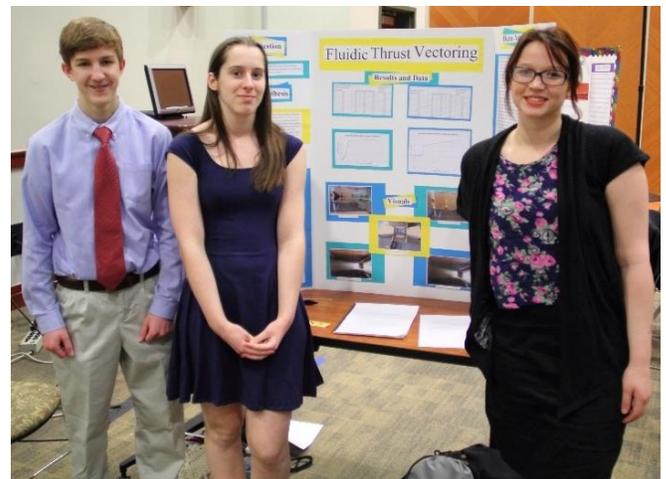
His robot features various feedback control aspects such as shaft encoders, infrared sensors, and gyro sensors. He is also able to control the robot using a remote control device. The robot is quite large and he was clearly comfortable with the hands on aspects of building such a complex machine.

Frederick is interested in pursuing studies in the bioengineering, aerospace engineering, or mathematics fields. Being recognized with the Hon. Eddie B. Johnson’s Excellence in Science Award Third Place, and the IEEE’s First Place Certificate of Merit, offers him many options.

**Prince William – Manassas Regional Science Fair**

At the Prince William County Kelly Leadership Center on March 14, 2015, the AIAA-NCS judging team of Tapan Joshi (Northrop Grumman), David Myre (senior AIAA member, TASC), Daniel Uhlig (Aurora Flight Sciences), and Michael Poliszuk (JSF F-35 Joint Program Office Lead Class Desk Engineer) reached consensus on their awards after considering the projects in the Senior Division of the regional fair.

***First Place: “Fluid Thrust Vectoring”***



The team of **Katherine Crim, Martha Hartt, and William Perez**, from the Governor's School at Innovation Park, earned their award in the category of Engineering. Will, a junior, was AIAA-NCS's third place awardee in 2014 in this same category.

Katherine, Martha, and Will hypothesized that by injecting a secondary fluid into a jet exhaust stream, it would be possible to change the output angle of the exhaust and the velocity of the primary mass flow rate. The apparatus they created consisted of a wind tunnel with a suction fan system, a conventional smoke machine to permit airflow visualization, an anemometer, and a tail fin wind vane. Compressed air at 60 psi was injected into the test section via tubing. A Plexiglas window in the test section allowed for flow visualization. The team was able to observe visually, and measure, the deflection in the exhaust stream. The visual demonstration of how main air flow changed its direction as secondary air flow was injected was outstanding. The team showed creativity by developing an experiment using very simple equipment and clearly demonstrated appropriate depth of knowledge of the theory behind the project and of the results.

The team won Third Place in the Engineering category at the fair and awards from the Yale Scientific & Engineering Association, Air Force, and first place from the Armed Forces Communication and Electronics Association (AFCEA), a major sponsor of the fair.

### ***Second Place: "Hydration Regulation"***



**Kalli Dalrymple** is a freshman at Seton High School, a private school in Manassas. Her project also earned Second Place in her category of Medicine & Health. She hypothesized that hydration plays a direct role in athletic performance.

Kalli clearly explained that the reason she chose swimmer athletes as the subjects of her study was because their performance could be objectively measured by timing them. She distinguished between beginners and more experienced athletes and designed a survey questionnaire for all participants to characterize their physical state.

Her results showed that hydration does affect athlete performance, and she was able to validate her raw data with a statistical model. The overall project, including design & planning, data acquisition and sampling, demonstrated a robust approach to performing life science research.

Kalli was awarded the Distinguished Achievement Award from the U.S. Public Health Service and an award from the Virginia Dental Society.

### ***Third Place: "Axial Coherence of a Thermoacoustic Laser"***



**Anne Bray** entered her project in the category of Physics, in which she was awarded First Place at the fair. She is in 10<sup>th</sup> grade at Osbourn High School in Manassas City. Her hypothesis posed that a thermoacoustic laser is axially coherent.

She took measurements to determine if omnidirectional output is present. The apparatus consisted of a thermoacoustic engine, acoustic

sensors, and a robotic arm to move the sensors to measure sound pressure at various locations.

Anne demonstrated how sound waves are generated through a laser. Her data acquisition method was noteworthy in that she used an open source Python script for data reduction to validate her hypothesis.

The use of a robotic transverse to move acoustic sensors showed her innovative approach to data collection. She demonstrated the results of her experiments and data sampling with graphs and tables. Based on the results of the experiment, she successfully demonstrated that a thermoacoustic laser is, indeed, axially coherent.

Anne received the First Place award from the International Electric & Electronic Engineers (IEEE) and the first place Distinguished Achievement Award from the Optical Society of America.

### **Loudoun County Public Schools Regional Science & Engineering Fair**

On Thursday, March 19, 2015, the Loudoun County Public Schools Regional Science & Engineering Fair was held at Freedom High School in South Riding, Virginia. The 34th annual event involved over 220 high school students from Loudoun County. Five judges representing AIAA-NCS selected 12 to 16 projects for judging and narrowed the field to five candidates for award.

The AIAA-NCS judges were: Patrick Alsup (Orbital ATK, Master Engineer), Melvin Greer (AIAA Senior Fellow, Lockheed Martin), Richard Zwierko (NASA/HQ - HEOMD/HSCD CN000, Risk & Asset Protection Manager), Dr. Mark Pittelkau (GNC System Engineer/Consultant Aerospace Control Systems, LLC), and Steve Kinaman (ATK).

#### ***First Place: “Using Nitrogen-Doped Titanium Dioxide to Perform Photocatalytic***

### ***Water Splitting for the Production of Hydrogen Gas”***



**Surbhi Singh** attends the Loudoun Academy of Science and Broad Run High School as a junior. She entered her project in the Chemistry category in which she also received First Place from the Fair’s judges.

The purpose of Surbhi’s research was to increase the photocatalytic efficiency of nitrogen-doped titanium dioxide to produce hydrogen fuel. The experiment was very well done. Examination of her notebooks indicated that she had expended effort to compile information on this topic over an extended period, with focused thought to the objectives and the potential return on investment (ROI) for an interesting problem regarding development of alternative energy sources.

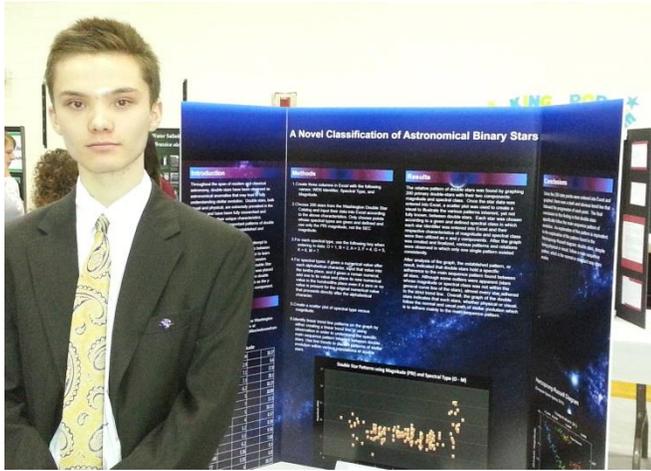
Surbhi stated in her abstract that, “One of the biggest problems in the world is finding alternate energy sources. Despite the large quantities that are found all over the world, hydrogen does not occur naturally. The process of water splitting is a chemical reaction that separates hydrogen from oxygen and is being widely investigated due to its ability to create large amounts of hydrogen gas.”

Surbhi’s presentation was organized, flowed freely, and was confidently indicative of knowledge of the subject gained from the research commensurate with the grade level. She maintained a uniform level of interest, and summarized the pertinent facts relative to a practical application without deviating from the stated project purpose. The display was neatly

organized for readability and aligned well with her verbal presentation.

Surbhi was able to discuss and respond to questions on the process and the research, including potential “what if” and practical applications, and also to the reasons for selecting this subject as a school science project. The Northern Virginia Dental Society awarded Surbhi their Chemistry Award, one of nine given to excellent projects.

### ***Second Place: “A Novel Classification of Astronomical Binary Stars”***



**John Shimazaki** is a senior who attends Dominion High School. He entered his project in the Physics & Astronomy category, in which he received Honorable Mention for his project.

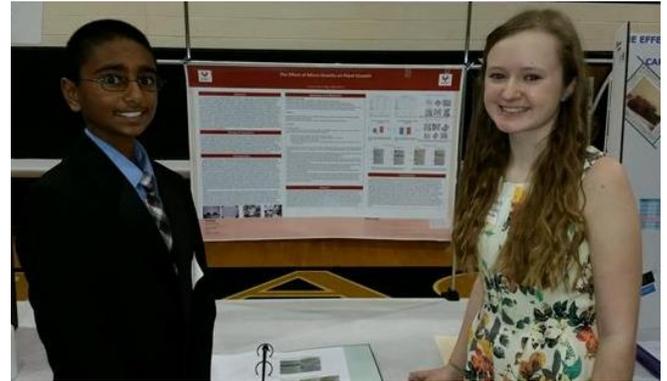
The purpose of John’s research was to visually generate and illustrate patterns between visual and actual double stars to facilitate understanding of their evolutionary progression. The display and graphics supporting the experiment objective were not only top-notch visually but also meticulously organized and laid out to convey the pertinent results of the research without verbal explanation.

As a presentation medium, this was one of the better sets of graphics in appearance and in format for information displayed. John presented a detailed and enthusiastic summary of his information research that included the relevance of the conclusions drawn from this research, and the rationale for the what, how, and why it supported his objective.

A lot of his knowledge on the subject appears to have been derived from his extracurricular interest

in Astronomy over an extended period of time. His stated near term future plans included the potential for him to shadow a researcher in Astronomy at Harvard during the summer. Orbital ATK, Inc. honored his project with their Innovation Award for his category.

### ***Third Place: “The Effect of Microgravity on Plant Growth”***



The team of **Santosh Krishnan** and **Gwyneth Schloer**, from Rock Ridge High School, entered their project in the Plant Sciences category.

The purpose of their research was to examine how plants grow in micro-gravity in the absence of light. This team of ninth graders did a notable job in discussing the aspects of their project in terms of objectives and considerations of the process they employed to complete the activity.

From the team’s abstract, “In this experiment, basil and tomato were inserted into a gel and were left in either a micro-gravity chamber or a box in a dark room for a period of nine days. Every three days, the root and plant growth were observed. At the end of the nine days, the roots were measured, weighed, and the cell structure was observed. This experiment is important because it shows that if circumstances require plants to be grown in space, we know how important it is to have them exposed to light.”

Realistically, the project couldn’t address the effects of true microgravity; however, their discussions and answers relative to the judging team’s questions clearly indicated that they had thought through the physics of the experiment actually conducted. As was used in an actual space experiment, Santosh and Gwyneth employed a rotating device to account for gravity.

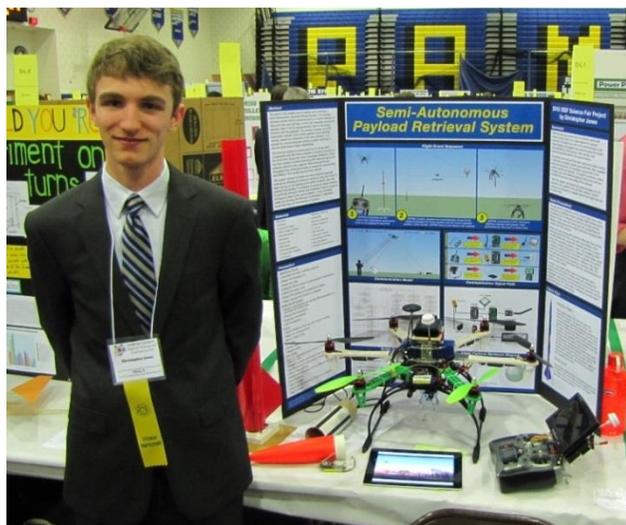
Although true microgravity effects could only be approximated, their insight and thought processes for the project demonstrated creative analytical judgment necessary in the sciences. The two-week project period was limited by the life of the plant material under the stated conditions. Their project received an Innovation Award from Orbital ATK, Inc.

## Fairfax County Regional Science & Engineering Fair

The Fairfax County Regional Science and Engineering Fair was held on March 21, 2015 at Robinson Secondary School in Fairfax, VA. The AIAA NCS judges were Francis Szalay (ARES Corp), Michael Poliszuk (JSF F-35 Joint Program Office), Vincent Chernesky (NAVSEA), David Myre (TASC), and Josh Powers (O3b Networks).

The Fairfax Regional Fair boasted over 440 projects presented by students in grades 9-12. With the help of Judging Teams Coordinator, Susan Bardenhagen, previewing the abstract listings, the judges went through the list of projects and selected the candidates that would be interviewed. After talking with a lot of excited students, and evaluating many impressive entries, the judges decided the following students deserved special recognition:

### *First Place: “Developing a Semiautonomous Payload Retrieval System”*



First place went to sophomore **Christopher Jones**, from West Potomac High School in the Engineering: Mechanics category. He also received the First Place award in his category and

was a Grand Award Nominee. In 2014, Christopher received AIAA-NCS’s second place award in the category of Physics & Astronomy.

Christopher's project involved writing a program that aimed to autonomously control a multi-rotor craft to track and find the payload dropped by parachute from a model rocket, using a GPS signal, and to transfer control back to himself so he could capture the payload using a remote camera. Finally, the payload would return to his location.

Christopher's drive to learn the programming and electronics skills necessary to complete this ambitious project is to be commended. It is notable that he also received many accolades including: a Boeing Defense Certificate of Merit, the Patent & Trademark Office First Place Certificate of Merit, the Rodger H. Flagg Memorial Award for Innovation, and Honorable Mention and Invitation to Present at The Aerospace Corporation’s Herndon Science Event.

### *Second Place: “Blended Wing Body Aircraft – The Future of Air Travel”*



**Jonathan Grow** is a junior at Langley High School. He also was an awardee of AIAA-NCS in 2014, receiving first place in the Energy & Transportation category. His project this year was entered in the category of Engineering: Mechanics in which he received the fair’s Second Place award.

Jonathan's intent was to design a blended wing body aircraft that would aerodynamically

outperform a Boeing 777. Jonathan showed the judges excellent engineering knowledge with his design process and in his use of X-Plane simulation software to test his designs using real world conditions.

Jonathan also built a 1/40<sup>th</sup> scale model of his final design. He received the Office of Naval Research Gift Certificate and Medal.

### ***Third Place: "The Effect of Three Conditions of Wings on Time Aloft"***



Freshmen **Vinh Nguyen** and **Courtney Lee**, from Chantilly High School entered their team project in the category of Physics and Astronomy, earning Third Place from the Fair in this category.

Their project investigated the effect of changing the material, shape, and number of wings on the flight time of water-powered bottle rockets.

The judges were impressed with their attention to detail in the development and execution of their experiment. Vinh and Courtney accounted for multiple independent variables and kept exceptional records throughout the life of their project. The judges wanted to recognize their excellent use of the engineering approach to their project's topic.

### **Prince George's Area Science Fair**

At Charles Herbert Flowers High School in Springdale, Maryland, the 67<sup>th</sup> annual Science Fair, "*Dreaming Today to Discover Tomorrow: Producing the Next Generation of STEM Leaders*," was held on March 14, 2015. The fair's participants included students from Prince George's, St. Mary's, and Calvert County Schools. Our awardees represent each of the three counties.

The five person judging team included: David Benson (NASA), Tapan Joshi (Northrop Grumman), Ashish Purekar (University of Maryland Senior Scientist, InnoVital Systems, Inc.), Thomas Noyes (Graduate Student-Department of Aerospace Engineering, University of Maryland; Director of Business Development-NextBus, Inc., a division of Cubic Corporation), and Nathan Shumway (Graduate Student-Department of Aerospace Engineering, University of Maryland).

### ***First Place: "Exosuits for the Common Man"***

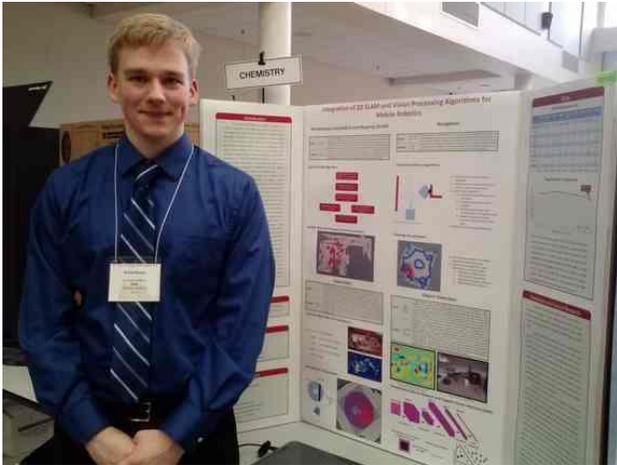


**Chris Crunkleton** entered his 21<sup>st</sup> century creation in the Engineering: Electrical & Mechanical category. He attends Northern High School in Calvert County.

With this project, Chris demonstrated an exosuit prototype that he had built that enhances the strength of the wearer. The suit adds 55 lbs of lifting force and weighs 19 lbs. It is worn like a backpack and has a compressor that feeds a pneumatic system which, in turn, assists in lifting and lowering objects. Chris discussed using the exosuit to help astronauts lift heavy objects on other planets.

Chris was recognized by the Office of Naval Research with a Certificate of Achievement.

***Second Place: “2D SLAM and Vision for Mobile Robotics”***



**Michael Stevens** entered his project in the Computer Science category, in which he received First Place. He is a senior and attends Eleanor Roosevelt High School in Prince George’s County.

Michael’s project detailed work he had done in conjunction with the University of Maryland’s Computer Vision lab. Here he had worked with a robot that could sense its environment. The robot was equipped with a Microsoft Kinetic, making it capable of driving towards obstacles and identifying some objects. Michael discussed using his technology in the exploration of Mars.

Michael was recognized by both the Office of Naval Research with a Certificate of Achievement and the Yale Science & Engineering Association, Inc.

***Third Place: “Wind Turbine Blades Efficacy”***



**Savannah Jabr** entered her project in the Energy & Transportation category. She is in 8<sup>th</sup> grade at Spring Ridge Middle School in St. Mary’s County.

Through this project, Savannah determined the optimal blade angle of a set of angles, for a wind turbine, to maximize efficiency. She constructed several different turbine heads, with equally sized blades set at various angles, and tested them with a leaf blower. She determined the optimally efficient angle to be approximately 15 degrees.

Savannah was also awarded the Broadcom Masters First Place award in her category. This event is the middle school level equivalent to the International Science & Engineering Festival for high school students. In addition, the Society of Women Engineers acknowledged her as a Promising Engineer, the Office of Naval Research awarded a Certificate of Achievement, and the Educational Systems Federal Credit Union presented her with their STEM Award.

**Charles County Science Fair**

Originally scheduled for March 7<sup>th</sup>, the Charles County Science Fair was postponed for three weeks due to snow and icy conditions. From a scheduled team of three judges, only first-time judge, Shelby Highsmith (Institute for Defense Analyses), could attend on the new date. He accepted the challenge and consulted with other judges at the fair to confirm his decisions. The event was held, March 28, 2015, at Maurice McDonough High School in Pomfret, Maryland.

***First Place: “The Effect of a Car's Shape on its Aerodynamic Efficiency”***



**Robert Frederick** is a freshman at St. Charles High School. He entered his project in the Energy & Transportation category.

Looking at aerodynamics, Robert performed a wind tunnel drag test on car profiles. He constructed an effective force balance design.

Building a wind tunnel and consistently-sized scale model profiles of different car types was only the beginning of this experiment. Robert also developed an impressive suspension and force balance system to measure the minute drag force on each model from outside the tunnel, including calibration.

Robert earned first place in the Energy and Transportation category. He also won the Charles County Commissioner's Award, the Patuxent Partnership Award, and the United States Air Force Award.

### ***Second Place: "The Floating Axle Whipper Trebuchet"***



**Lukas Lawrence** is a junior at Thomas Stone High School, and he entered his project in the Engineering: Electrical & Mechanical category.

This project was a sophisticated continuation of previous work Luke had done in an effort to hurl a projectile over 200 yards. While he has not yet achieved that goal, his continuing work has demonstrated the dogged pursuit of the test-fix-test cycle of engineering development, including the correction of some dramatic failures along the way.

He built a series of trebuchets to maximize launch distance. Lukas used the traditional fly-fix-fly

approach to address the issues resulting from each trial.

Luke took first place in the Engineering: Electrical and Mechanical category. He also won the following awards: the Naval Surface Warfare Center-Indian Head Division, the Yale Science & Engineering Association, Inc., and the United States Air Force Award.

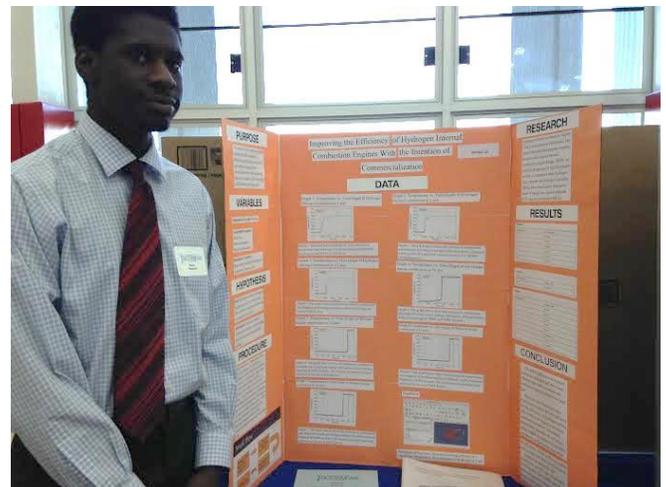
### **DC STEM Fair**

The final fair for the spring 2015 AIAA-NCS judging teams was held at Dunbar High School in Washington, DC on March 28, 2015. With spring break vacations scheduled, the team had just two judges on its roster: Jacinda Parales (U.S. Air Force) and Carl Schultheisz (National Transportation Safety Board).

Students participated from around the city. The Fair included a Junior division and a Senior division with projects that covered a wide range of topics. Two Senior division projects were selected for special AIAA-NCS recognition. Both projects were in the Engineering category.

### ***First Place: "Improving the Efficiency of Hydrogen Internal Combustion Engines with the Intention of Commercialization"***

**Herve Nyemeck** is a student at the School Without Walls. He reached out to experts in the field and was directed to the open source computational fluid dynamics program OpenFOAM, which required him to develop some skill in C++ in order to perform his simulations.



Herve investigated the combustion of hydrogen, methane and iso-octane in an oxygen environment

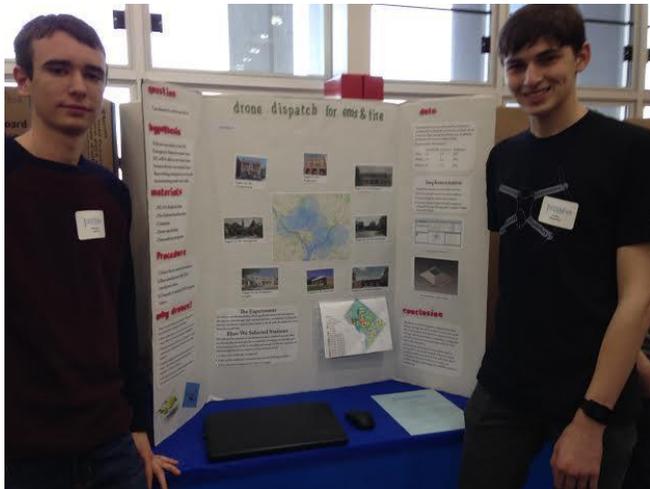
at different pressures. Based on the calculated reaction results, he concluded that hydrogen provided better efficiency than the other two fuels.

He recognized the limitations of his investigation in that he was relying on computational results that might not accurately represent a real-world situation, but he showed a lot of creativity and ingenuity in developing and pursuing the project.

Herve also received First Place from the category judges in Engineering at the Fair's award ceremony.

### ***Second Place: "Drone Dispatch for EMS and Fire"***

The team of **Sebastian Quilter** and **Tobias Shapinsky**, from Wilson High School received second place honors from AIAA-NCS. In their Engineering category they received an Honorable Mention at the awards ceremony at the Smithsonian Institution.



They presented their project as a feasibility study that examined the use of drones in Washington, DC for the purpose of saving lives and making the city a better place.

Their hypothesis was that drones stationed at DC fire houses could be used to deliver certain medical treatment devices (defibrillators or epinephrine auto-injectors), or provide situation assessments faster than an ambulance or fire engine, or provide a rapid evaluation to gunfire detected in Washington, DC.

They used a database of DC emergency medical services response times and measured drone speeds to compare expected response times

throughout the city, calculating an expected improvement in response time for the drones of 30% to 40%. They used Python, HTML and Java to develop an application where a location, chosen in Google Maps, would show the drone response time and the ambulance or fire engine responses times, near that location, from the database. They also created a CAD model for a drone docking station for the roofs of the fire houses.

Sebastian and Tobias recognized that there were a lot of obstacles (both regulatory and technological) to implementing this idea, but they did a thorough job of exploring the possibilities, and made use of a lot of different data and programming resources to complete their project.

### **Plans for Next Year**

AIAA-NCS intends to continue supporting the region's science fairs in 2016. While NCS leadership is committed to this very worthwhile endeavor, it only works with the support of corporate and individual sponsorship, and the participation of volunteer judges. If you are interested in getting more involved in AIAA-NCS educational outreach programs, please contact Michele McMurrer at [aiaancs1@aol.com](mailto:aiaancs1@aol.com).

### **Our sincere thanks to:**

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- **SpaceX**

#### ***The Science Fair Judges:***

- **Northern Virginia:**
  - Josh Powers (O3b Networks)
  - Dr. Nils Jespersen (Aerospace Corp.)
  - Dr. John Retelle (DARPA/Strategic Engineering Solutions LLC)
- **Montgomery County:**
  - Margaret Shaw (Lockheed Martin)
  - Michael Martin (AAAS/Department of Energy)

- Thomas Noyes (Graduate Student-Department of Aerospace Engineering, University of Maryland; Director of Business Development- NextBus, Inc., a division of Cubic Corporation)
- Daniel Oropeza (Lockheed Martin)
- **Prince William-Manassas:**
  - Tapan Joshi (Northrop Grumman)
  - David Myre (senior AIAA member, TASC)
  - Daniel Uhlig (Aurora Flight Sciences)
  - Michael Poliszuk (JSF F-35 Joint Program Office Lead Class Desk Engineer)
- **Loudoun County:**
  - Patrick Alsup (Orbital ATK, Master Engineer)
  - Melvin Greer (AIAA Senior Fellow, Lockheed Martin)
  - Richard Zwierko (NASA/HQ - HEOMD/HSCD CN000, Risk & Asset Protection Manager)
  - Dr. Mark Pittelkau (GNC System Engineer/Consultant Aerospace Control Systems, LLC)
  - Steve Kinaman (ATK)
- **Fairfax County:**
  - Francis Szalay (ARES Corp)
  - Michael Poliszuk (JSF F-35 Joint Program Office)
  - Vincent Chernesky (NAVSEA)
  - David Myre (TASC)
  - Josh Powers (O3b Networks)
- **Prince George's County:**
  - David Benson (NASA)
  - Tapan Joshi (Northrop Grumman)
  - Ashish Purekar (University of Maryland Senior Scientist)
  - InnoVital Systems, Inc.)
  - Thomas Noyes (Graduate Student-Department of Aerospace Engineering, University of Maryland; Director of Business Development- NextBus, Inc., a division of Cubic Corporation)
  - Nathan Shumway (Graduate Student-Department of Aerospace Engineering, University of Maryland)
- **Charles County:**
  - Shelby Highsmith (Institute for Defense Analyses)

- **District of Columbia:**
  - Jacinda Parales (U.S. Air Force)
  - Carl Schultheisz (National Transportation Safety Board)

***And finally, the AIAA-NCS Science Fair team:***

During the 2014-2015 academic year, the following AIAA-NCS Science Fair Committee members worked very hard to make this year's AIAA science fair coverage a success:

- **Dr. Natalia Sizov**, AIAA-NCS Lead Science Fair Coordinator
- **Dr. Nils Jespersen**, Student Winner Liaison
- **Susan Bardenhagen**, Judging Teams/Fairs Co-Coordinator
- **Scott Fry**, Judging Teams/Fairs Co-Coordinator
- **Dr. Supriya Banerjee**, AIAA-NCS Chair and Fund Raising
- **Michele McMurrer**, AIAA-NCS Administrator