Acoustical Society of America at the 2018 Intel International Science and Engineering Fair

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The Intel International Science and Engineering Fair (ISEF; bit.ly/1m2gRQG) is a program of the Society for Science and the Public (societyforscience.org) and is the world's largest international precollege science competition. The Intel ISEF can be thought of as the "Super Bowl" of science fairs. Each year, approximately 7 million high-school students from around the world compete in local science competitions. This year, of those, only 1,800 finalists from 75 countries advanced to showcase their research at the 2018 Intel ISEF that took place in Pittsburgh, PA. Each affiliated regional science fair from around the world can send a prespecified number of participants to the Intel ISEF each year. The finalists competed for over $4 million in awards and scholarships.

In addition to the Intel ISEF Grand Awards, more than 60 Special Awards Organizations (SAOs; bit.ly/2MKjDxt) also provide awards. SAOs are corporations, government agencies, universities, or nonprofits that sponsor educational scholarships, cash prizes, summer internships, scientific field trips, equipment grants, and more for finalists at the Intel ISEF. The 1,800 finalists were eligible for both Intel ISEF Grand Awards and SAO Awards. The American Society of America (ASA) began participating in the SAO program in 1978 to promote acoustics specifically and to recognize the accomplishments of students, mentors, and schools. The longtime participation of the ASA in the Intel ISEF recognizes the importance of promoting STEM education and generating interest in acoustics among all students. In addition to the $6,300 in cash prize award money, the ASA contributes $2,500 to the Intel ISEF Award Program to support local, national, and international media coverage. Keeta Jones, the ASA Education and Outreach Coordinator, works with the Intel ISEF staff to organize the involvement of the ASA with the fair. She also makes announcements to local ASA members to ask them volunteer their time and expertise as judges. The judges must have a minimum of six years of related professional experience beyond receiving their BA, BS, or masters degrees; have a PhD, MD, or the equivalent; or be a current doctoral student with more than four years of doctoral-level research experience or who is within one year of doctoral dissertation defense.

The fair took place from May 13 to 19, 2018. The ASA judging team was led by Jeffrey Vipperman and included Jeff Babich and Laurie Heller. Mr. Babich is president and principal consultant at Babich Acoustics, Pittsburgh, a company that focuses heavily on architectural acoustics, noise control, and test/measurement. Dr. Heller is a professor at Carnegie Mellon University, Pittsburgh. Her research focuses on hearing, psychoacoustics, environmental sounds, and signal detection. Dr. Vipperman is a professor at the University of Pittsburgh. His research focuses on active/passive noise control, noise classifiers, structural acoustics, acoustic cloaking, and noise-induced hearing loss (NIHL). Dr. Vipperman, as ASA head judge, presented the awards to the three winners at the Special Awards Ceremony on May 17, 2018.

Those eligible for the ASA cash prize awards were chosen by the three ASA judges from the Intel ISEF finalists. They first searched through the 1,800 titles and abstracts for acoustics relevance (defined in the broadest sense). The relevant projects were then reviewed and cut to the 35 top projects that had acoustics as a primary focus of the research. Most, if not all, of the 13 technical areas of ASA were represented.

The ASA judges then met and discussed the 35 projects, and each judge chose to be a primary or secondary judge for various projects. Next, the primary and secondary judges prejudged the projects by reading the student's poster boards (see **Figure 1**), documentation, and lab notebooks in the absence of the student. From there, the judges selected 20 projects for student interviews. A total of five semifinalists were selected and reinterviewed once or twice more by the entire panel of ASA judges.

After much deliberation, first, second, and third place finalists were chosen and received cash prizes for themselves, their schools, and their mentors. The first place winner received $1,500 plus $200 for the school and $500 for the mentor. The second place finalist received $1,000 plus $100 for the school and $250 for the mentor. The third place finalist received $600 plus $150 cash prize for the mentor. An honorable mention certificate was also awarded. Additionally, the student winners have been invited to attend the upcoming ASA annual meeting in Victoria, BC, Canada. For photos of this and past Special Award Ceremonies, see the Intel ISEF ASA Flickr album at bit.ly/2NKiO3O.

The first place ASA winner was Anwesha Mukherjee (Robotics and Intelligent Machines Category). Ms. Mukherjee is a 10th grader at Westview High School, Portland, OR. She was mentored by teacher Debbie Cooper with a project entitled "A Novel Approach to Recognize Emotion from Speech Using Machine Learning Algorithms to Aid Social Interaction of Kids with Autism." The goal of this project was to aid autistic children in their development of empathy and social interactions by using cues from speech to help compensate for difficulties in reading facial expressions. Ms. Mukherjee's contribution over previous work was developing a heuristic weighting of the mel-frequency cepstral coefficients (MFCCs) that improve classifier accuracy by an additional 3-12%. She investigated a number of machine-learning algorithms and found that the multinomial logistic regression provided the most accuracy for her metrics. Her system was trained and tested using a database of expressive speech. See her full project abstract at bit.ly/2oSSj1H. Ms. Mukherjee also received the Intel ISEF Best of Robotics and Intelligence Category Second Place Award.

Figure 1. *Poster session at the Intel International Science and Engineering Fair.*

The second place ASA winner was Sharmi Shah, an 11th grader from Colonia High School, Colonia, NJ, mentored by teacher James Danch (Physics and Astronomy Category). Ms. Shah's project was "Speech Intelligibility Analysis of Sound-Modulated Laser Signal Countermeasures." It is well established that laser light can be used as a spying device by measuring the modulation of the reflected light from a window. Ms. Shah investigated two coatings for their ability to diffuse the laser light and prevent eavesdropping while maintaining optical clarity. She evaluated the two coatings plus a control by using speech-recognition software to analyze speech recorded by the laser. Silica nanoparticle-epoxy residue reduced intelligibility of the chosen speech by 47% while nanoparticle-dimethylsiloxane fully precluded speech intelligibility by the algorithms. Although the coatings appeared transparent, transmission spectra were measured for the control and coated samples and found that the light transmission was very minorly impacted. The project abstract is available at bit.ly/2wN4S2W. Ms. Shah also received the US Air Force First Place Award in Physics and Astronomy, the National Security Agency (NSA) Research Directorate Physical Sciences First Place Award, and the Intel ISEF Best of Physics and Astronomy Category Fourth Place Award.

An 11th grader, Gabrielle Liu (Systems Software Category), from Ravenwood High School, Brentwood, TN, and mentored by teacher Peter Lowen, took third place. Ms. Liu's project, "Preventing Domestic Violence Using Emotion Recognition in Speech" also used machine learning to monitor emotions but as a screen to pick up domestic violence. She envisions incorporating her algorithms in the burgeoning prevalent use of artificial intelligence personal assistants.

They would serve as a "risk barometer" by monitoring the emotional state of a household in real time. As such, domestic violence could be detected in its early phases. Ms. Liu developed a tiered neural network architecture based on nontext prosodic, acoustic, statistical, and spectral features of speech and then evaluated her algorithms using a library of spoken speech with emotion. The project abstract is available at bit.ly/2NQkCsb. Ms Liu also received the Samvid Education Foundation's Geno Third Place Award.

Honorable mention went to Rohan Ahluwalia (Biomedical Engineering Category), also from Westview High School and also mentored by teacher Debbie Cooper. Mr. Ahluwalia's project was "A Fully Functional Closed- Loop System Using Ultrasound Imaging to Automatically Detect Lipohypertrophy in People with Insulin-Dependent Diabetes." Lipohypertrophy is an accumulation of fat under the skin that occurs in diabetics who self-administer multiple daily injections. Early detection is key to preventing a much more painful and unsightly condition. Mr. Ahluwalia developed an edge-detection algorithm that can discern early-stage lipohypertrophy using ultrasound images that cannot be otherwise detected by sight or feel. Using a database of ultrasound images, his algorithm was determined to be correct 85% of the time. Human trials of his device also proved successful. Mr. Ahluwalia abstract is available at bit.ly/2wPbRHF.

The judges look forward to the many great accomplishments and leadership from the many talented youth who participated in the Intel ISEF.