Engineer develops new approach for uncertainty estimation, wins award

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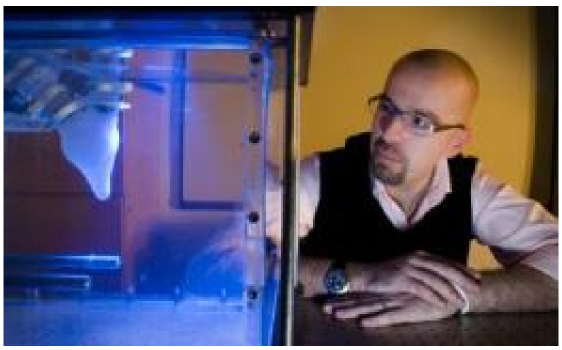

Pavlos Vlachos, associate professor of mechanical engineering at Virginia Tech and director of the Advanced Experimental Thermofluid Engineering Research Laboratory, is a recipient of the 2009 Lewis F. Moody Award. Credit: Virginia Tech Photo

Pavlos Vlachos, associate professor of mechanical engineering at Virginia Tech, working with two engineers from Utah State University, has won the Lewis F. Moody Award for an outstanding original paper useful to the practice of mechanical engineering.

The Moody Award, established in 1958 by the American Society of Mechanical Engineers' Fluids Engineering Division, will be presented to Vlachos and his two colleagues, Benjamin Timmins and Barton Smith of the mechanical engineering department at Utah State, at the annual international meeting of the society in Hamamatsu, Japan in July.

The three devised a new method to estimate uncertainty in a specific type of flow measurement, termed particle image velocimetry.

"Particle image velocimetry currently is the most widely used method in experimental fluid mechanics. It is used extensively to validate numerical simulations for the study of the aerodynamics of aircrafts and vehicles, the hydrodynamics of ships, power plant modeling, turbomachinery, cooling of equipment, and even biomedical uses such as measuring the blood flow through veins and arteries. It was even used to measure the flow rate for the recent oil–spill in the Gulf of Mexico " Vlachos explained.

But before these results can be trusted and used, they must be "validated, and their uncertainty must be determined," he added. "A failure to do so can result in inaccurate models, flawed test results, wrong predictions or inefficient designs. However, to date, no practical and accepted method existed for estimating particle image velocity uncertainty."

Hence, the three engineers developed a methodology to estimate the uncertainties for these various types of studies, by accounting for the degree by which "sources of errors in the measured velocities affect the uncertainty," Vlachos said. The new method measures parameters such as the diameter of a particle image, density, and different grades of velocity.

Then the code automatically estimates the uncertainty of each vector in particle image velocimetry measurements. With the new measurements, they are able to provide an estimate of the velocity uncertainty for each vector in the flow field. Their work lays the foundation for a particle image velocity uncertainty quantification method that will significantly increase the usefulness and reliability of such measurements and have a widespread impact on flow measurements.

Previously, Vlachos received the 2009 outstanding paper award from the American Institute of Physics' Journal of Measurement Science and Technology for his work in fluid mechanics and particle image velocimetry measurement.

Vlachos, a 2006 recipient of a National Science Foundation CAREER Award, is the director of the Advanced Experimental Thermofluid Engineering Research Laboratory at Virginia Tech.

He has established a world-renowned program in the development and use of time-dependent digital particle image velocimetry for flow measurement.

Provided by Virginia Tech

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