AAE SPECIAL SEMINAR

Measuring Pressure Distribution to Achieve Better Understanding of Flow Physics

THURSDAY OCTOBER 10TH, 2024
4:30PM-5:20PM ARMS B071

DR. XIAOFENG LIU

Department of Aerospace Engineering
San Diego State University

Abstract
In this talk, I will first briefly review the state of the art of the non-intrusive pressure measurement methods in fluid flow, with an emphasis on the discussion of the evolution of the Omni-Directional Integration (ODI) algorithm over the past two decades. Especially, the true advantage of ODI over the conventional Poisson equation solver will be shown through theoretical demonstration. The ODI computational procedure can provide Dirichlet boundary conditions for pressure (and any scalar field) reconstruction, which is enabled by the exponential error decay mechanism inherent to the algorithm through boundary pressure iteration. The ultimate dense line limit of ODI leads to its new form called the Green's Function Integral (GFI), the connections of the two will be shown in the talk. The extension of the ODI computation capability from simply connected domain to multiply connected domain will be illustrated through comparisons with ground truth data of Direct Numerical Simulations of an isotropic turbulence flow and a bubble collapse process, respectively. Two examples of physics revealed through non-intrusive pressure distribution measurements, including the sound generation mechanism of turbulent shear layer flow over a cavity trailing corner, and the opposite phase fluctuations of the viscous drag and the pressure drag in free bubble rising in quiescent water, will be presented in the talk. In addition, the impact of the ODI /GFI algorithm on the solutions to a variety of problems will also be reported, with examples shown from the experimental characterization of the free surface elevation, to the hypersonic density field reconstruction, and to the significant enhancement of the accuracy of the adjoint data assimilation of a subdomain in an isotropic turbulent flow.

Biography
Dr. Xiaofeng Liu, an associate fellow of the American Institute of Aeronautics and Astronautics (AIAA), is currently an associate professor and the graduate advisor at the Department of Aerospace Engineering at San Diego State University (SDSU). Before joining SDSU, he was first a postdoctoral fellow, and subsequently an assistant research scientist at the Department of Mechanical Engineering at Johns Hopkins University. He received his Bachelor and Master degrees in aerodynamics from Beijing University of Aeronautics and Astronautics, and a Ph.D. degree in aerospace engineering from the University of Notre Dame. Before joining Notre Dame, he was a lecturer at Tsinghua University. Dr. Liu has extensive experience in flow diagnostics. His research interest includes high-lift aerodynamics, turbulent shear layer and wake flows, vortex dynamics, cavitation, bubble dynamics, jet atomization, flow-structure interactions, acoustics, data assimilation and non-intrusive pressure and scalar measurement techniques.
Dr. Liu is a U.S. citizen. He has been appointed as an ONR Summer Faculty Fellow /Senior Fellow since 2016, working in NSWC Carderock Division and the U.S. Naval Research Laboratory, respectively. He is the recipient of the Best Faculty Award and the Most Influential Faculty Award from SDSU, and the Outstanding Contribution to Aerospace Education Award from AIAA San Diego Section, respectively.

PURDUE UNIVERSITY | School of Aeronautics and Astronautics

EA/EOU