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Numerical Simulation Study of Hypersonic Boundary-Layer Receptivity to Freestream Disturbances and a New Transition Suppression Methodology by Surface Roughness

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ABSTRACT:

Due to the difficulty in conducting hypersonic boundary layer transition experiments and the complexity of hypersonic flow involving various instability mechanisms, fundamental studies of hypersonic boundary layer transition are increasingly relying on the use of numerical simulation as a research tool. In this talk, I will first present our research in numerical-simulation and theoretical analysis of physical mechanisms of hypersonic boundary-layer receptivity, instability, and transition. Such studies can lead to a better Amplitude Method for the prediction of boundary-layer transition. Subsequently, I will present our computational and theoretical studies of the effects of surface roughness on the stability and transition of hypersonic boundary layers, the results of which are the basis of our passive transition control methodology by means of judiciously placed surface roughness elements. The potential practical applications of the new technique to the development of hypersonic vehicles will be discussed.

BIOGRAPHY:

Professor Xiaolin Zhong received his Ph.D. degree in Aeronautics and Astronautics from Stanford University in 1991. Since his graduation from Stanford, he has been a faculty member of the Mechanical and Aerospace Engineering Department at UCLA (Assistant Professor: 91-97, Associate Professor: 97-02, Professor: 02-present), where he is currently a professor and the department chair. His main research areas are computational fluid dynamics (CFD), computational nonequilibrium hypersonic flows, and the stability and transition of high-speed boundary layers. He is an Associate Fellow of AIAA and was an Associate Editor of the AIAA Journal from 2005 to 2015.