# APCOM Seminar

Graduate School of Science and Technology, Keio University
Date/time: June 1st, 2016, 18:30 to 19:30
Place: 3rd floor of Bldg 16A (厚生棟大会議室)

## “Network-theoretic analysis of unsteady fluid flows”

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**Abstract:** Fluid flows exhibit rich dynamics over a range of spatial and temporal scales from the their nonlinear interactions. Identification of important interactions present in the flow field can reveal deeper insights into flow physics and may enable interaction-based control of fluid flows. In an effort to understand and characterize the complex web of interactions present in the flow field, we examine the use of network and graph theories on examining unsteady fluid flows. In the talk, we will discuss three problems to highlight the strength of network analysis. We first consider quantifying the vortical interactions for clusters of potential vortices and derive the sparsified dynamics model. The formulation is then extended to examine turbulent flows, revealing the structures of turbulence networks and their network characteristics. Furthermore, we show preliminary findings on network-based analysis to examine kinetic energy transfer in open cavity flows. From these examples, we demonstrate that the current network-based approaches are able to highlight important nonlinear interactions in the flow field that we not readily captured by traditional analyses. We will also present an overview of the CFD and active flow control efforts undertaken by our research group.

References:

- G. Nair and K. Taira, "Network-theoretic approach to sparsified discrete vortex dynamics," Journal of Fluid Mechanics, 768, 549-571, 2015.
- K. Taira, A. G. Nair, and S. L. Brunton, "Network structure of two-dimensional decaying isotropic turbulence," Journal of Fluid Mechanics, 795, R2, 1-11, 2016.

**Biosketch**: Kunihiko Taira is an Assistant Professor of Mechanical Engineering at the Florida State University. He received his B.S. in Aerospace Engineering with a double major in Mathematics from the University of Tennessee, Knoxville and both his M.S. and Ph.D. in Mechanical Engineering from the California Institute of Technology. Prior to his current position, he was a postdoctoral research associate at Princeton University and worked for the Fundamental Technology Research Center at Honda R&D Co., Ltd in Japan. His research focuses on computational fluid dynamics, flow control, and unsteady aerodynamics. He is the recipient of the 2013 Young Investigator Award from the US Air Force Office of Scientific Research and the 2016 Young Investigator Award from the US Office of Naval Research.

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