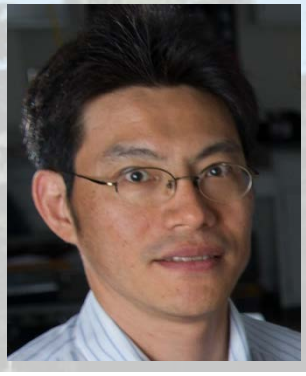
Control Group Seminar
Tokyo Institute of Technology

Cellular Actuators inspired by Biological Muscles

Date: 13:30-14:30 June 23 (Fri.), 2017
Room: W8 E-1001



Associate Professor, Jun Ueda

G.W.W. School of Mechanical Engineering,
Georgia Institute of Technology, USA

Abstract:

Actuators are one of the key components in robotic and mechatronic systems. Motions generated by actuators enable computer-controlled systems to interact with the physical world. Inspired by unique characteristics of biological muscles, a system-level approach was taken to design, fabricate, control, and analyze new robotic actuators, resulting in a unique and powerful methodology for biologically inspired actuation. In this talk, the concept of cellular actuation is introduced, where mechanical structures with an array of single amplified piezoelectric actuators operate in parallel or series according to the needs of the application. Such actuators are fast and provide smooth contraction, which is interesting for human-like movements in arms and eyes.

The cellular actuator architecture is a paradigm for generating robotic movement inspired by the way human musculature is organized. This allows robotic systems to capture two key advantages of biological systems, namely, high resiliency to damage and natural smooth human-like movement. Motion is produced by the collective action of individual units contracting independently in an ON–OFF manner. The reason that this works, both in biology and in the cellular actuation system, is because there is elastic material joining the units together.

Controlling the cellular actuator presents an entirely different paradigm from traditional servo motors due to its highly redundant architecture. The talk presents various control methods that have been developed for highly modular actuation systems. The stochastic broadcast feedback control method allows each actuator unit to act as an independent agent in response to a single broadcast command. Several interesting robotic devices enabled by the cellular actuator technology are presented including variable stiffness actuators, self-sensing robotic grippers, saccadic robotic eyes, and wearable assistive devices.

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Bio:

2002年3月	京都大学大学院工学研究科機械工学専攻博士課程修了. 博士（工学）
1996～2000年	三菱電機先端技術総合研究所勤務.
2002～2008年	奈良先端科学技術大学院大学情報科学研究科助手.
2005～2008年	Massachusetts Institute of Technology 客員研究員および講師.
2006～2008年	日本学術振興会海外特別研究員.
2008年5月より	Georgia Institute of Technology, Mechanical Engineering, Assistant Professor.
2014年	Associate Professor となり現在に至る.
2015～2017年	Director for Robotics PhD Program at Georgia Tech.
2016年より	ASME Dynamics Measurement & Control Division, Biosystems and Healthcare Technical Committee Chair.
2004年	ファナックFA ロボット財団論文賞特別賞受賞.
2009年	IEEE Robotics and Automation Society Early Academic Career Award 受賞.
2015年	Advanced Robotics Best Paper Award 受賞.