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Physics-based Machine Perception for Robotics and Intelligent Machines

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ABSTRACT:

Over the past three decades, machine perception has grown in concert with rapidly advancing 4C (computer, communication, control, and consumer-product) and AI technologies through several paradigm shifts that transform 4C from desktop microprocessors to palms and to cloud. The growth has contributed greatly to robotics and intelligent machines which play increasingly important roles in many emerging applications where more and more smart real-time functions are expected in highly complex systems involving multi-physics in small footprints. This talk presents machine perception methods to take advantage of the physics-based models and computational intelligence to enable machines to have an adequate perception for analyzing system performance and making decisions in real-time. The methods utilize embedded sensors to reconstruct the physic fields from finite measurements and estimate the essential parameters and variables of the dynamic systems. The modeling, sensing, and estimation of the machine perception methods will be illustrated in the context of two sensing design applications for robotics, automation, and mechatronic. The first is a multi-task sensing system that uses an eddy-current field as a medium to simultaneously measure the displacement, thickness, and electrical conductivity of the workpiece. The second is an anatomy-based assistive robotic exoskeleton with multi-degree-of-freedom joint sensors for early-stroke rehabilitation

BIOGRAPHY:

Kok-Meng Lee (kokmeng.lee@me.gatech.edu) received his M. S. and Ph. D. degrees in mechanical engineering from the Massachusetts Institute of Technology in 1982 and 1985, respectively. He has been with the Georgia Institute of Technology since 1985. As a professor of mechanical engineering, his research interests include system dynamics and control, machine vision, robotics, automation, and mechatronics.

Dr. Lee is the founding Editor-in-Chief (EIC) for the Springer International Journal of Intelligent Robotics and Applications (IJIRA). Before becoming IJIRA EIC, he served as EIC for the IEEE/ASME Transactions on Mechatronics (2008-2013). He co-founded the IEEE/ASME International Conference on Advanced Intelligent Mechatronics in 1997 and hosted its following edition (AIM1999) as General Chair in Atlanta, USA. He had also held representative positions in the IEEE Robotics and Automation Society; Associate Editor for its Robotics and Automation Magazine (1994-1996) and its Transactions on Robotics and Automation (1994-1998) and Automation Science and Engineering (2003-2005). He served on the Executive Committee of ASME Dynamics Systems and Control Division (2013-2107, Chair 2016). He co-authored four books on modeling and field-based approaches for the design and control of electromagnetic actuators and flexonic systems and has held several patents on machine vision systems, ball-joint-like spherical motors, and automated systems for transferring live objects.

Dr. Lee is a Life Fellow of ASME and IEEE. Other recognition of his research contributions includes the Presidential Young Investigator (PYI) Award, Sigma Xi Junior Faculty Award, International Hall of Fame New Technology Award, Woodruff Faculty Fellow, and Michael J. Rabins Leadership Award.