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A Transverse Feedback Linearization Approach to Controlling Dynamical Systems under State Space Constraints

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Abstract:

In this talk, we introduce a new transverse feedback control problem with applications to Eye and Head movement, described as a constrained dynamical system on SO(3) from the point of view of a nonlinear multi input multi output system. The constraint on the system was originally proposed by Donders and Listing in the mid-nineteenth century. In this talk we assume that eyes and head are controlled by a triplet of external torques provided by muscles. The outputs of the dynamical system are chosen as follows. Two of the output signals are coordinates of the frontal pointing direction. The third signal measures deviation of the state vector from the constraint surface. Extending our results to the binocular eye movement problem, the gaze directions of the two eyes are additionally constrained to stay focused, i.e. meet at a point in space. We obtain a 6 by 6 square system and show that the system is semi-globally feedback linearizable for points satisfying the Donders' constraint.

Biography:

Bijoy Ghosh received his Ph.D. degree in Engineering Sciences from the Division of Applied Sciences, Harvard University, USA in 1983. From 1983 to 2007 he was with the Department of Electrical and Systems Engineering, Washington University, St. Louis, USA, where he was a Professor and Director of the Center for BioCybernetics and Intelligent Systems. Currently he is a Regent Professor of Mathematics and Statistics at Texas Tech University, TX, USA. He received the Donald P. Eckmann award in 1988 from the American Automatic Control Council, the Japan Society for the Promotion of Sciences Invitation Fellowship in 1997. He is a Fellow of the IEEE and a Fellow of IFAC. He has held visiting positions at Tokyo Institute of Technology, Osaka University, University of Padova, Royal Institute of Technology, Institut Mittag-Leffler, Yale University, Technical University of Munich and the Chinese Academy of Sciences among others. Bijoy's current research interest is in BioMechanics, Cyberphysical Systems and Control Problems in Rehabilitation Engineering.