Constrained robust and adaptive control over reproducing kernel Hilbert spaces with aerospace applications

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Abstract: Reproducing kernel Hilbert spaces (RKHSs) have proven to be a powerful tool in machine learning (ML) for their ability to provide sharp bounds on error in estimating unknown functions in both the deterministic and stochastic settings. A key feature of RKHSs is that the estimation error can be expressed in terms of the power function and the fill distance between the kernel function centers. In this presentation, we will discuss how robust adaptive control systems have been designed leveraging RKHS theory to capture matched uncertainties. The barrier functions underlying these control systems guarantee user-defined levels of performance in terms of tracking error and allow pruning or adding kernel centers according to precision and computational effort needs. The feasibility of these results is demonstrated using an open-source numerical simulator for multi-rotor UAVs (uncrewed aerial vehicles) based on the finite-element method and distributed on GitHub.

Bio: Andrea L'Afflitto received the B.S. degree in Aerospace Engineering and the M.S. degree in Aerospace Engineering and Astronautics from the University of Napoli "Federico II," Italy, in 2004 and 2006, respectively. He later earned an M.S. degree in Mathematics from Virginia Tech in 2010 and a Ph.D. in Aerospace Engineering from Georgia Tech in 2015. From 2008 to 2009, he worked as a System Engineer at the German Aerospace Agency (DLR) in Cologne, Germany. He then served as an assistant professor at the University of Oklahoma from 2015 to 2019 before joining Virginia Tech in 2019, where he is currently an associate professor in the Grado Department of Industrial and Systems Engineering. Prof. L'Afflitto's research focuses on robust and adaptive control, nonlinear control, optimal control theory, and the control of unmanned aerial systems, with applications in aerospace and automotive engineering. He is the author of three books and more than 60 journal and conference publications. His contributions have been recognized with several honors, including the DARPA Young Faculty Award (2018) and his appointment as an AIAA Associate Fellow. He currently serves as an Associate Editor-in-Chief for the Autonomous Systems track of the IEEE Transactions on Aerospace and Electronic Systems, served as the Publications Chair for ACC 2026, and is a member of the IEEE Aerospace Controls Technical Committee.