VILLANOVA UNIVERSITY

MECHANICAL ENGINEERING DEPARTMENT

Spring 2020 SEMINAR SERIES

Seminar Date: January 21th, 2020

Lecture: Continuum Deformation Approaches to Large Scale UAS Coordination and Traffic Management

Speaker: Hossein Rastgoftar, Ph.D, Aerospace Engineering Department, University of Michigan

Abstract:
This presentation discusses continuum deformation modeling of coordination of a large number of aerial vehicles treated as particles of deformable bodies (or continuum). Assuming desired coordination of an unmanned aerial system (UAS) team is the solution of Laplace equation, Lagrangian and Eulerian continuum mechanics will be applied to safely plan UAS coordination in a finite airspace. The Lagrangian continuum mechanics is used to manage large-scale coordination of a UAS team in a cluttered environment when the total number of agents is fixed. In this context, we optimize a large-scale continuum deformation coordination, and formally specify and verify collision-free collective motion with minimal communication and computation overhead, enabling distance between individual UAVs to significantly change while assuring the vehicles do not collide. Furthermore, the Eulerian continuum mechanics can be applied to achieve freely scalable coordination and manage traffic coordination in a finite airspace. Using the Eulerian description of continuum mechanics, the space and time allocated to an individual UAS can be effectively managed and the airspace capacity can be maximized through controlling UAS inflow and outflow at the airspace boundaries with minimum computation overhead. In particular, the airspace can be classified into planned and unplanned spaces by dynamically updating planned-unplanned airspace boundaries while nominal coordination is obtained as the solution of a governing PDE with spatiotemporal cyber-physical parameters.

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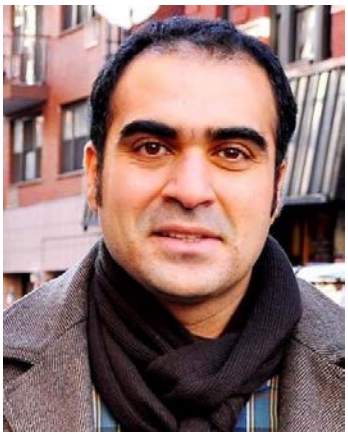
Biography:



Dr. Hossein Rastgoftar is an Assistant Research Scientist in the Aerospace Engineering Department at the University of Michigan. Prior to that he was a postdoctoral researcher at the University of Michigan from 2015-2017. He received his Ph.D. in Mechanical Engineering from Drexel University in 2015. He has two MS degrees (one in Mechanical Systems and the other in Solid Mechanics) and a BSc degree in Mechanical Engineering-Thermo-Fluids. Dr. Rastgoftar has worked on decision-making, optimization, large-scale UAS coordination, traffic control, and autonomy over the past four years at the University of Michigan, and has published several archival journal papers and peer-reviewed conference papers. He is the sole author of the book "Continuum Deformation of Multi-Agent System" published by Springer (https://www.springer.com/gp/book/9783319415932).

Host: Prof. Hashem Ashrafiuon