Cooperative Control of Unmanned Aircraft for Improved Forecasts of Hurricanes and Typhoons

Dr. Derek A. Paley
Assistant Professor
University of Maryland
Department of Aerospace Engineering
dpaley@umd.edu

Abstract

Like the United States and Caribbean, Taiwan incurs tremendous loss of life and property due to tropical cyclones. Catastrophic consequences of a hurricane/typhoon landfall can be mitigated by providing emergency responders with accurate forecasts of storm track and intensity. The accuracy of storm-track forecasts have improved recently due to improvements in numerical weather modeling and prediction. However, the storm-intensity forecasts have not seen a similar improvement, partly because of a dearth of in situ observations of the hurricane boundary layer at the air-sea interface. (Manned aircraft known as Hurricane Hunters do not fly below ten thousand feet.) For the past several hurricane seasons, NOAA scientists have piloted a small unmanned aircraft known as the Aerosonde into the eye of selected North Atlantic hurricanes, where it collects low-level observations vital to intensity forecasts. There is a critical need to develop intelligent, optimal controls to enable one or more unmanned aircraft to autonomously and cooperatively observe tropical cyclones in the Atlantic and Pacific Oceans. The research objective is to combine numerical models of the atmosphere with feedback-control methods from nonlinear systems theory to investigate adaptive observing strategies for reducing hurricane forecast errors by optimally targeting multiple unmanned aircraft. This research would lead to improved strategies for decentralized control of unmanned vehicles in environments with time-varying and strong flow dynamics.

Bibliography

Derek A. Paley is an Assistant Professor in the Department of Aerospace Engineering at the University of Maryland and the Director of the Collective Dynamics and Control Lab. He received the B.S. degree in Applied Physics from Yale University in

1997 and the Ph.D. degree in Mechanical and Aerospace Engineering from Princeton University in 2007. His research interests are in the area of nonlinear dynamics and control, including cooperative control of autonomous vehicles, adaptive sampling with mobile sensor networks, and spatial modeling of biological collectives.