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Coordinated in-situ observation of developing hurricanes using atmospheric balloons – a Model Predictive Control approach GIANLUCA MENEGHELLO, THOMAS BEWLEY, Flow Control Lab, UC San Diego — Current operational methods used to monitor the development of hurricanes and typhoons include radar and satellite imagery as well as dropsondes parachuted from repeated aircraft flights above the hurricane itself. The accurate in-situ measurements provided by dropsondes are especially valuable for generating an accurate forecast of a hurricane's evolution and landfall. Unfortunately, the data from dropsondes is expensive to obtain (requiring many hazardous high-altitude flights) and limited both spatially (to the vertical profile of its path) and temporally (to the ten or twenty minutes it takes to fall). We show in the present work how receding-horizon MPC can be used to coordinate a formation of sensor-laden atmospheric balloons, distributing them quasi-uniformly across a realistic developing hurricane flowfield for days at a time. Several atmospheric balloons can be released from a high-altitude aircraft, or launched from a ship at sea level, and distributed over the hurricane thereafter. Certain target orbits of interest in the hurricane can be continuously sampled by some balloons, while other balloons make continuous sweeps between the eye and the spiral rain bands. Various solution methods for the optimal control problem arising within the MPC framework are considered.

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