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Pseudo Volume-filling Sampling (PVS) via Bouyancy Control in Hurricane and Ocean Systems ROBERT KROHN, DAVID ZHANG, THOMAS BEWLEY, UC San Diego — This project addresses improved sensing methods for modeling and prediction in two seemingly disparate applications, hurricane systems and ocean currents. In such applications, well distributed measurements of important flow quantities such as the local fluid velocity, temperature, and pressure are quite valuable. Such measurements can be obtained from very simple sensor systems. For example, thousands of sensor-equipped balloons may be released by a cargo plane making a single pass over a hurricane. Thousands of sensor-equipped floats have in fact already been distributed over the oceans of the earth in the Argo project. The challenge in both cases is to distribute the sensors uniformly over the volumes of interest. In both cases, the sensor systems are grossly underactuated, and are only capable of controlling their vertical motion. Given that an accurate estimate of the background velocity field is available in both applications, however, it is possible to "fly" each individual sensor system, much as a recreational balloonist can direct a balloon accurately by exploiting known velocity shear within the atmosphere. The present work addresses how an entire network of such underactuated sensor systems can distributed uniformly over a domain of interest, using both global model predictive control (MPC) regulated centrally and, in certain well-defined subproblems, simple LQG-based strategies implemented locally.

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