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Sparse sensor placement for machine learning classification of pitching and plunging plates JONATHAN TU, NSWC Carderock — We consider the task of using downstream measurements to characterize the upstream motion of a rigid flat plate, which can be thought of as a simplified model of a swimming fish. Specifically, we numerically simulate pitching and plunging plates at a Reynolds number of 100, then apply Linear Discriminant Analysis (LDA) to distinguish between the two upstream motions. To reduce the dimension of the feature space, we apply LDA to projection coefficients of the flow field obtained using proper orthogonal decomposition (POD). However, at inference time this still requires collecting full flow field data, in order to perform the POD projection. To avoid having to collect full flow fields at all, we also use the Sparse Sensor Placement Optimization for Classification (SSPOC) algorithm to find a small number of point sensors that provide the same information as a POD projection. We implement both the original algorithm and a new extension of SSPOC for vector-valued measurements. Whereas the standard SSPOC algorithm might choose certain sensor locations for the u velocity and others for the v velocity, our vector SSPOC algorithm places sensors for u and v at the same locations. Classification using either SSPOC variant achieves similar accuracy to that using full flow field data.

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