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Sensor Placement in Multiscale Phenomena using Multi-Resolution Dynamic Mode Decomposition KRITHIKA MANOHAR, EURIKA KAISER, STEVEN L. BRUNTON, J. NATHAN KUTZ, University of Washington — Multiscale processes pose challenges in determining modal decompositions with physical meaning which can render sensor placement particularly difficult. Localized features in space or time may play a crucial role for the phenomenon of interest but may be insufficiently resolved due to their low energy contribution. We consider optimal sensor placement using spatial interpolation points within the framework of data-driven modal decompositions. In recent years, the Discrete Empirical Interpolation Method or DEIM and variants like QDEIM have gained popularity for interpolating nonlinear terms arising in model reduction using Proper Orthogonal Decomposition modes. We extend this sensor placement approach to multiscale physics problems using Multi-Resolution Dynamic Mode Decomposition or mrDMD (Kutz et al., 2015), an unsupervised multi-resolution analysis in the time-frequency domain that separates flow features occurring at different timescales. The discovered sensors achieve accurate flow state reconstruction in representative multiscale examples including global ocean temperature data with an energetic El Niño mode. Interestingly, this method places sensors near coastlines without imposing additional constraints, which is beneficial from an engineering perspective.

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