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Extending Dynamic Mode Decomposition: A Data–Driven Approximation of the Koopman Operator[1] MATTHEW WILLIAMS, IOANNIS KEVREKIDIS, CLARENCE ROWLEY, Princeton University — In recent years, Koopman spectral analysis has become a popular tool for the decomposition and study of fluid flows. One benefit of the Koopman approach is that it generates a set of spatial modes, called Koopman modes, whose evolution is determined by the corresponding set of Koopman eigenvalues. Furthermore, these modes are valid globally, and not only in some small neighborhood of a fixed point. A popular method for approximating the Koopman modes and eigenvalues is Dynamic Mode Decomposition (DMD). In this talk, we show that DMD approximates the Koopman *eigenfunctions*, but uses linear monomials to do so; this may be limiting in certain applications. We then introduce an extension of DMD, which we refer to as Extended DMD (EDMD), that uses a richer set of user determined basis functions to approximate the Koopman eigenfunctions. We demonstrate the impact this difference has on the eigenvalues and modes by applying DMD and EDMD to some simple example problems. Although the algorithms for DMD and EDMD appear to be similar, modifications like the ones we will present can be important if the resulting eigenvalues, eigenfunctions, and modes are to accurately approximate those of the Koopman operator.

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Matthew Williams
Princeton University

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