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On least-order flow decompositions for aerodynamics and aeroacoustics[1] MICHAEL SCHLEGEL, Berlin Institute of Technology, Germany, BERND R. NOACK, PETER JORDAN, Institute PPRIME, France — A generalisation of proper orthogonal decomposition (POD) for optimal flow resolution of linearly related observables is presented, as proposed in the identically named publication of Schlegel, Noack, Jordan, Dillmann, Groeschel, Schroeder, Wei, Freund, Lehmann and Tadmor (Journal of Fluid Mechanics 2012, vol. 697, pp. 367–398). This Galerkin expansion, termed "observable inferred decomposition" (OID), addresses a need in aerodynamic and aeroacoustic applications by identifying the modes contributing most to these observables. Thus, OID constitutes a building block for physical understanding, least-biased conditional sampling, state estimation and control design. From a continuum of OID versions, two variants are tailored for purposes of observer and control design, respectively. Three aerodynamic and aeroacoustic observables are studied: (1) lift and drag fluctuation of a two-dimensional cylinder wake flow, (2) aeroacoustic density fluctuations measured by a sensor array and emitted from a two-dimensional compressible mixing layer, and (3) aeroacoustic pressure monitored by a sensor array and emitted from a three-dimensional compressible jet. The most "drag-related," "lift-related" and "loud" structures are distilled and interpreted in terms of known physical processes.

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