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A data-driven decomposition approach to model aerodynamic forces on flapping airfoils[1] MARCO RAIOLA, STEFANO DISCETTI, ANDREA IANIRO, Universidad Carlos III De Madrid — In this work, we exploit a data-driven decomposition of experimental data from a flapping airfoil experiment with the aim of isolating the main contributions to the aerodynamic force and obtaining a phenomenological model. Experiments are carried out on a NACA 0012 airfoil in forward flight with both heaving and pitching motion. Velocity measurements of the near field are carried out with Planar PIV while force measurements are performed with a load cell. The phase-averaged velocity fields are transformed into the wing-fixed reference frame, allowing for a description of the field in a domain with fixed boundaries. The decomposition of the flow field is performed by means of the POD applied on the velocity fluctuations and then extended to the phase-averaged force data by means of the Extended POD approach. This choice is justified by the simple consideration that aerodynamic forces determine the largest contributions to the energetic balance in the flow field. Only the first 6 modes have a relevant contribution to the force. A clear relationship can be drawn between the force and the flow field modes. Moreover, the force modes are closely related (yet slightly different) to the contributions of the classic potential models in literature, allowing for their correction.

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