Exotic states of bouncing and walking droplets

We present the results of an integrated experimental and theoretical investigation of droplets bouncing on a vibrating fluid bath. A comprehensive series of experiments provides the most detailed characterisation to date of the system's dependence on fluid properties, droplet size, and vibrational forcing. A number of new bouncing and walking states are reported, including complex periodic and aperiodic motions. Particular attention is given to the first characterisation of the different gaits arising within the walking regime. In addition to complex periodic walkers and limping droplets, we highlight a previously unreported mixed state, in which the droplet switches periodically between two distinct walking modes. Our experiments are complemented by a theoretical study based on our previous developments [J. Molacek and J. W. M. Bush, J. Fluid Mech.727, 582-611 (2013);10.1017/jfm.2013.279J. Molacek and J. W. M. Bush, J. Fluid Mech.727, 612-647 (2013)]10.1017/jfm.2013.280, which provide a basis for rationalising all observed bouncing and walking states.