Oscillatory motions of an active deformable particle

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Shape deformation of micro-organism such as living cells and bacterias plays an important role for its active motion. Active motions accompanied with shape deformation have also been observed in non-biological systems such as spontaneously-moving oil droplets. Among active motions, there are a lot of experiments of a soft particle which undergoes a spinning motion. Such active spinning motions can be divided into two types considering the mechanism; one is a spinning motion due to the emergence of an angular momentum in side the particle, such as a spontaneously spinning oil droplet [1]. The other is related to a chemical wave inside the particle [2] or traveling waves on the interface [3].
Previously [4], we have introduced a set of time-evolution equations by considering an anti-symmetric tensor variable as well as the velocity of the venter of mass and a symmetric tensor variable representing deformation. The anti-symmetric tensor variable is directly related to an angular momentum, therefore our previous model is applicable for the first-type spinning motion.
In this presentation, we would like to talk about our recent research [5] concerning the second-type active spinning motion. That is, the dynamics of an active deformable particle which undergoes a spinning motion where the interfacial motion plays an important role. In two dimensions, the deformations are expanded in terms of the Fourier series and the couplings of different modes are taken into consideration truncated up to lower orders. We emphasize a special symmetry of the coupled equations for different Fourier-mode deformations As an example, we show that there exist oscillatory bifurcations, where the particle undergoes either a spinning motion or a standing oscillation of shape deformations. Both numerical and theoretical analyses have been carried out to understand the dynamics.

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