5.3 Golestanian's swimmer model

This part is copied (with very minor adaptations) from the article of Golestanian and Ajdari [GA07], for their excellent discussion is difficult, if not impossible, to improve.

5.3.1 Three-sphere swimmer: simplified analysis

As a minimal model of a low Reynolds number swimmer, consider three spheres of radii a_i $(i = 1, 2, 3)$ that are separated by two arms of lengths L_1 and L_2. Each sphere exerts a force F_i on, and experiences a force $-F_i$ from, the fluid that we assume to be along the swimmer axis. In the limit $a_i/L_j \ll 1$, we can use the Oseen tensor (5.15) to relate the forces and the velocities as

$$v_1 = \frac{F_1}{6\pi\mu a_1} + \frac{F_2}{4\pi\mu L_1} + \frac{F_3}{4\pi\mu(L_1+L_2)}, \tag{5.23a}$$

$$v_2 = \frac{F_1}{4\pi\mu L_1} + \frac{F_2}{6\pi\mu a_2} + \frac{F_3}{4\pi\mu L_2}, \tag{5.23b}$$

$$v_3 = \frac{F_1}{4\pi\mu(L_1+L_2)} + \frac{F_2}{4\pi\mu L_2} + \frac{F_3}{6\pi\mu a_3}. \tag{5.23c}$$