Supplementary Figures

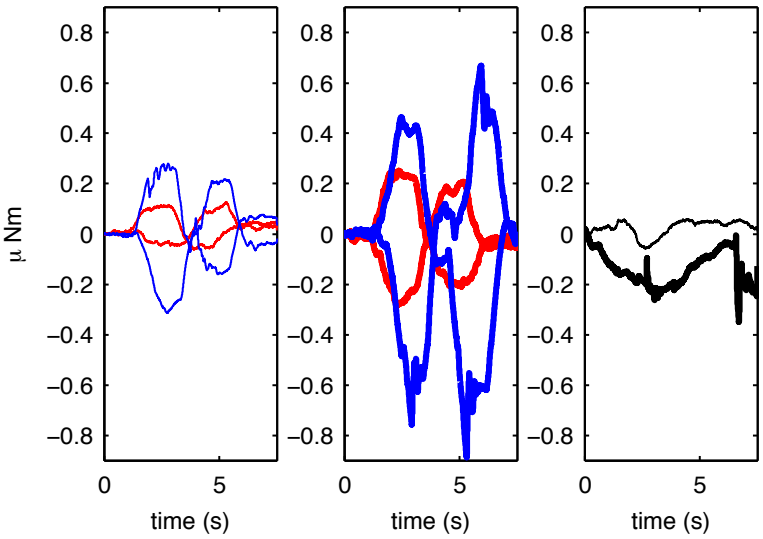

Figure 1: The wire tether behaves like a spring. To measure torques, a number of different wire tethers were attached to a sensitive capacitive torque sensor [1] and deformed. Measuring torque by rotating the sensor relative to the dangling wire tether was impossible because rotation significantly distorted the torque signal because of deflection induced by the mass of sensor components. Accordingly, the sensor was instead held fixed while the tether dangled from it. The tether was physically moved by resting it on the same black fabric material from which the vehicle normally takes off, and moving this laterally a fixed distance below the sensor while position was measured by ruler so that the wire was subject to known angular deflections of 20° (red) and 45° (blue). Two tests were performed for each angle, one in which a positive angle was initially induced and another in which a negative angle was initially induced. (left, thin lines) Four-wire tether used in experiment in Figure 4. Other four-wire tethers tested exhibited similar behavior. (middle, thick lines) Tests on the tether used in ocelli feedback trials that included both the four-wire control tether and the additional six-wire tether needed for ocelli feedback. Spikes in the data correspond to when the tether performed sudden conformational changes, such as twisting free. The four-wire tether imparted a torque of approximately 0.25 µNm per 45°, which is a spring constant k_s=0.3 µNm/rad. The ten-wire tether was approximately twice as stiff, imparting a torque of approximately 0.6 µNm per 45° or k_s=0.8 µNm/rad. (right) Experiment in which the tether was moved downward away from the torque sensor to a distance of 7 cm to mimic a vertical takeoff flight, for four-wire (thin) and ten-wire (thick) tethers.

References

[1] Benjamin M Finio, Kevin C Galloway, and Robert J Wood. An ultra-high precision, high bandwidth torque sensor for microrobotics applications. In *Intelligent Robots and Systems (IROS), 2011 IEEE/RSJ International Conference on*, pages 31–38, 2011.