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Statistical Modeling of an Optically Trapped Cilium JUSTIN FLAHERTY, ANDREW RESNICK, Cleveland State Univ — We explore, analytically and experimentally, the stochastic dynamics of a biologically significant slender microcantilever, the primary cilium, held within an optical trap. Primary cilia are cellular organelles, present on most vertebrate cells, hypothesized to function as a fluid flow sensor. The mechanical properties of a cilium remain incompletely characterized. Optical trapping is an ideal method to probe the mechanical response of a cilium due to the spatial localization and non-contact nature of the applied force. However, analysis of an optically trapped cilium is complicated both by the geometry of a cilium and boundary conditions. Here, we present experimentally measured mean-squared displacement data of trapped cilia where the trapping force is oppositely directed to the elastic restoring force of the ciliary axoneme, analytical modeling results deriving the mean-squared displacement of a trapped cilium using the Langevin approach, and apply our analytical results to the experimental data. We demonstrate that mechanical properties of the cilium can be accurately determined and efficiently extracted from the data using our model. It is hoped that improved measurements will result in deeper understanding of the biological function of cellular flow sensing by this organelle.

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