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Statics and dynamics of planar shearable filaments in viscous fluid: A Cosserat rod approach HERMES GADELHA, EAMONN GAFFNEY, ALAIN GORIELY, Mathematical Institute, University of Oxford — Cilia and flagella are ubiquitous in biology as a means of motility and constitute one of the most incredible engineering works of nature. Their inner core, namely the axoneme, consists of a remarkable phylogenetically conserved cytoskeletal structure formed by an assembly of semifexible filaments interconnected by crosslinking proteins. As a result, the flagellum or cilium is not only capable to flexure under the action of an external load, but also to shear. The latter is however a consequence from the intricate elastic crosslinking proteins which causes the elastic bending to couple with shearing deformations, modifying dramatically the effective mechanical response of these bundles of filamentous polymers. We consider deformations of nonlinearly elastic slender rods immersed in a fluid, and analyse the differences between the elastic cross-link shear response and pure material shear resistance under the action of viscous dissipation. We show that pure material shearing effects from Timoshenko's beam theory or, equivalently, Cosserat Rod Theory are fundamentally different from elastic crosslink induced shear found in filament bundles, such as the axoneme.

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