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**Efficient filament elastohydrodynamics in 3D** BENJAMIN WALKER, University of Oxford, KENTA ISHIMOTO, Kyoto University, EAMONN GAFFNEY, University of Oxford — The coupled elastohydrodynamics of flexible slender filaments in a viscous fluid have long represented a significant computational challenge, with the inertia-free system exhibiting severe numerical stiffness. Recently, much of this stiffness was circumvented by integrating the governing equations of elasticity and imposing a simple discretisation, yielding a computational framework capable of filament simulation on a laptop computer in a matter of seconds. However, this approach has previously been limited to purely planar motion, reliant on a tangent angle parameterisation in order to be cast as ordinary differential equations that may be efficiently solved. In this talk, we will present an extension of this approach to the motion of inextensible unshearable filaments in three spatial dimensions, numerically avoiding the gimbal lock problem typically associated with Euler angles via adaptive basis selection. We will demonstrate by explicit example that this leads to an efficient framework for filament simulation in 3D, reducing computation times from hours on high performance computing clusters to seconds on a modest laptop, thus enabling thorough and large scale study into a range of biological and biophysical filament problems.

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