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KEYNOTE LECTURE: A FORMULATION FOR FLUID-STRUCTURE INTERACTION AT THE MICROMETER SCALE

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Abstract. Many things are different, even counter-intuitive, at very small scales. Among them, solid articulated bodies become very rigid (the resonant frequencies of members get very high) and they thus are better modeled by multibody dynamics than by continuum mechanics (elasticity, etc.). The equations of the solid bodies, then, are written in terms of generalized coordinates, Lagrangians, Hamiltonians, as taught in courses of Classical Mechanics. At the same time, if such bodies are immersed in a liquid, their movement is determined by fluid/solid interaction forces that result from the Eulerian velocity-pressure formulation of the fluid's behavior. In this work we show how to cast the interaction problem into a single formulation that allows for the coupled update of the solid's generalized coordinates and the fluid's Eulerian fields. Considering that inertia is very small at the micron scale, coupled algorithms such as those proposed in this presentation are the only viable choice for reliably computing biological or artificial microswimmers.