Shape Optimization of Micro-Magnetic Locomotors ERIC KEAV-
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Institute — Locomotion at the micro-scale is important in biology and in industrial
applications such as targeted drug delivery and micro-fluidics. We present results
on the optimal shape of a rigid body locomoting in 3-D Stokes flow. The actuation
consists of applying a fixed moment and constraining the body to only move along
the moment axis; this models the effect of an external magnetic torque on an object
made of magnetically susceptible material. The shape of the object is parametrized
by a 3-D centerline with a given cross-sectional shape. No a priori assumption is
made on the centerline. Thus, we pose an infinite dimensional optimization prob-
lem and solve it with Boundary Integral and Variational methods. Sensitivities of
the cost and constraints are computed variationally via shape differential calculus
and a boundary integral formulation yields the boundary stresses. The optimiza-
tion method can be considered as a sequential quadratic programming (SQP) ap-
proach. We report examples of locomotor shapes with and without different fixed
payload/cargo shapes.

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