Flexural propulsion

D. Bigoni¹*, F. Dal Corso¹, D. Misseroni¹, N. Pugno¹, A.B. Movchan², N.V. Movchan²

¹ DICAM University of Trento, Italy
bigoni@ing.unitn.it; francesco.dalcorso@ing.unitn.it; nicola.pugno@unitn.it; diego.misseroni@ing.unitn.it

² Department of Mathematical Sciences; University of Liverpool, UK
abm@liv.ac.uk; nvm@liv.ac.uk

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The problem is analysed of an elastic rod, straight in its undeformed configuration, and constrained within a rigid and frictionless curved channel, Fig. 1. This is a simplified version (in which friction is not considered) of the famous problem of snake locomotion analysed also by Gray [1-3] under the restrictive assumption that the rod is discretized in rigid pieces connected by rotational elastic springs.

The analysed problem is an example of an inflected structure dominated by configurational (or Eshelby-like) forces, as pointed out in [4], providing the locomotion to the system. The problem is analysed analytically (by using variational calculus and micromechanics), numerically (through ABAQUS simulations) and experimentally (with apparatuses ad hoc designed and realized). In particular, the propulsive force is derived taking into account a series of conditions never analysed before, but important to explain animal locomotion and to design compliant mechanical devices. The obtained results are fully validated through both simulations and experiments.

REFERENCES