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A Gedankenexperiment in micro-robotics: can a charged micro-robot experience the Maxwell–Lodge effect?

A. Grillo¹, A. Pastore¹, J.C. Harrop², D. Bigoni²

¹ *Politecnico di Torino/Dipartimento di Scienze Matematiche (DISMA) “G.L. Lagrange”.*
Corso Duca degli Abruzzi, 24, Torino TO, Italy

² *Università di Trento/Instability Lab. Via Mesiano, 77, Trento TN, Italy*

alfio.grillo@polito.it; andrea.pastore@polito.it; joel.harrop@unitn.it; davide.bigoni@unitn.it

Micro-robots are devices often used in biomechanics [1] and medicine, e.g. for the release of pharmaceuticals [2]. In the context of bio-inspired applications, micro-robots can be shaped as flagella [3] and are thus modeled as slender rods made of viscoelastic materials. A sufficiently deep physical insight into the mechanics of such structures can be gained by regarding them as systems of rigid bars, joined through viscoelastic hinges, and by concentrating the mass of the rods in the midpoints of the bars. The hinges concentrate the distributed elasticity and viscosity of the original structures in selected points of the equivalent systems made of rigid bars.

A mechanical system that may well suit the framework described above is Ziegler’s double pendulum [4, 5]. In our contribution, we consider one such device connected with a cart at one end and featuring a nonholonomic constraint at the other, like in [6]. However, at variance with [6], we assume that the structural element serving as a nonholonomic constraint is electrically charged, and we investigate the dynamic behavior of the considered system under the action of an electric field and of a magnetic field generated by an ideal solenoid. In particular, we propose a *Gedankenexperiment* in which the dynamics of the system, placed in the proximity of the solenoid, is influenced by the electric field outside it. This setting, analyzed in [7], may feature a manifestation of what is known in electromagnetism as the Maxwell–Lodge effect [8].

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References

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