

The Kirchhoff-Plateau problem

Giulia Bevilacqua

*Dipartimento di Scienze Matematiche “G.L. Lagrange”, Politecnico di Torino,
c.so Duca degli Abruzzi 24, I-10129 Torino, Italy.
giulia.bevilacqua@polito.it, giulia.bevilacqua1993@gmail.com*

Abstract

The Kirchhoff-Plateau problem concerns the equilibrium shapes of a system in which a flexible filament in the form of a closed loop is spanned by a liquid film, with the filament being modeled as a Kirchhoff rod and the action of the spanning surface being solely due to surface tension. Giusteri, Lussardi and Fried in [3] established the existence of an equilibrium shape that minimizes the total energy of the system under the physical constraint of non-interpenetration of matter, but allowing for points on the surface of the bounding loop to come into contact. In [1], we use this result to generalize the situation studying a system composed by several rods linked in an arbitrary way and tied by a soap film and we perform some experiments to validate our result.

We also study the Elastic Plateau problem, i.e. the above problem when the boundary is an elastic curve. In [2], we obtain the minimal energy solution of the Plateau problem with elastic boundary as a variational limit of the minima of the Kirchhoff-Plateau problems with a rod boundary when the cross-section of the rod vanishes. The limit boundary is a framed curve that can sustain bending and twisting.

References

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- [3] G.G. Giusteri, L. Lussardi, E. Fried, *Solution of the Kirchhoff-Plateau problem*, J. Nonlinear Sci. 27 (2017), 1043–1063.