Review of my contributions to modelling and computing in solid mechanics

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Abstract

I take a tour of my most important contributions to modelling and computing in solid mechanics made throughout my research career, dividing them into the following two groups:

1.- *Asymptotic methods*. Obtention of mathematical models for elastic, viscoelastic or piezoelectric beams using asymptotic methods as the diameter of the cross section tends to zero. Straight and curved beams (arches), solid and thin-walled sections (open and closed profiles) will be distinguished. The best-known classic bending-extension-torsion models in elasticity (Bernoulli, St. Venaint, Timoshenko and Vlasov) are rigorously justified and generalized. I will also show the use of this technique to obtain contact models with another solid for elastic and viscoelastic beams and shells.

2. - *Numerical methods*. Analysis and implementation of finite element methods with penalty-duality algorithms for solving the contact problems of an elasto-visco-plastic solid with another rigid or also deformable solid, including some examples of application in orthodontics. I will also show numerical simulation for a real application in design of steering wheels and another for human bone remodelling.

Main references

[1] Trabucho, L.; Viaño, J.M. (1996): *Mathematical Modelling of Rods*. In Handbook of Numerical Analysis, Vol. IV. Ciarlet, P.G.-Lions, J. L. Edts. North-Holland. pp. 487-974.

[2] Rodríguez-Arós, A.D.; Sofonea, M.; Viaño, J.M. (2007): Numerical analysis of a frictional contact problem for viscoelastic materials with long-term memory. Numer. Math. 108, pp. 327–358.