DYNAMIC ANALYSIS OF PRESTRESSED STRUCTURAL MEMBRANES

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Tension membrane structures are currently used in many different Civil Engineering fields. Under certain loading conditions, wrinkled and slack regions within an otherwise taut membrane surface may appear. This undesirable effect may be due to a series of factors such as an inadequate initial shape, an inappropriate prestressed distribution or, eventually due to excessive in-service loading conditions. The effect of dynamic loads in membrane structures is nowadays considered fundamental prior to any fluid-structure interaction analysis. Consistent linearisation procedures must be taken into consideration in order to minimise the computational time of the final algorithms. This seminar will introduce a computational framework for the dynamic analysis of prestressed or inflatable Saint-Venant Kirchhoff hyperelastic tension membranes.

The methodology originally developed in[1] is reformulated in an Updated Lagrangian Formulation along principal directions which enables the inclusion of a wrinkling algorithm based on a modified energy functional in a simple manner. The methodology is extended for dynamic simulations by means of an implicit algorithm based on the well established generalised-α method[2].

References

[1] A. J. Gil and J. Bonet. Finite Element Analysis of partly wrinkled reinforced prestressed membranes. *Computational Mechanics*, 40(3):595–615, 2007.

[2] J. Chung and G. M. Hulbert. A time integration algorithm for structural dynamics with improved numerical dissipation: the generalized-α method. *Journal of Applied Mechanics*, 60:371–375, 1993.