3D Analysis of wrinkles in film/substrate systems using Finite Element Method and Asymptotic Numerical Method

Ventura Pascal*[1], Michel Potier-Ferry†[2], Hajer Rezgui Chaabouni‡[3], Fan Xu§[4], and Frédéric Hecht¶[5]

[1]Laboratoire LEM3 UMR CNRS 7239 (LEM3) – Université de Lorraine – 7 rue Félix Savart, France
[2]Laboratoire LEM3 UMR CNRS 7239 (LEM3) – Université de Lorraine – France
[3]Laboratoire de Génie Civil, Diagnostic et Durabilité (GC2D) – Université de Limoges : EA3178 – Centre Universitaire de Génie CivilBoulevard Jacques Derche, 19300 Egletons, France
[4]Institute of Mechanics and Computational Engineering, Dept. of Aeronautics and Astronautics – Fudan University, Shanghai, Chine
[5]Laboratoire Jacques-Louis Lions (LJLL) – Université Pierre et Marie Curie - Paris 6, Université Paris Diderot - Paris 7, Centre National de la Recherche Scientifique : UMR7598 – Université Pierre et Marie Curie, Boîte courrier 187 - 75252 Paris Cedex 05, France

Résumé

The Asymptotic Numerical Method (ANM), (Potier-Ferry et al. [1]) is a robust continuation method for solving non linear fluid or solid mechanical problems that depends on a parameter.
Recently, Fan Xu [2], applied the ANM to simulate the non linear behavior film/substrate systems under various kind of applied forces using thin shell elements to take into account the stiff film. Following his pioneer work, in the case of 3D film/system under lateral compressive forces (at the film level), we decided to use the Finite Element Method (FEM) both for the stiff film and the compliant substrate, which allows accounting for various geometries, material properties and boundary conditions, and is more efficient in the case of short instability wavelength.

In this paper, we will show that the FreeFem++ Finite Element platform [3] can be successfully used to implement the ANM to simulate wrinkling behavior of 3D film/substrate systems.

Wrinkling phenomena in film/substrate systems often requires many degrees of freedom especially for 3D numerical models. Much effort has been spent to develop an efficient MPI parallel code in order to use High Performance Computing capabilities.

*Intervenant
†Auteur correspondant: michel.potier-ferry@univ-lorraine.fr
‡Auteur correspondant: hajer.rezgui@unilim.fr
§Auteur correspondant: fanxu@fudan.edu.cn
¶Auteur correspondant: frederic.hecht@sorbonne-universite.fr

Numerical results (bifurcation curves, deformed shape, ...) will be shown.

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Mots-Clés: MAN, MEF, Bifurcation