17:50–203A+B

A method for calculating the elastic wave band structure of two-dimensional phononic crystals with interface/surface stress effect

Wei Liu, Xianyue Su†

LTCS and Dept. of Mechanics and Aerospace Engineering, College of Engineering, Peking University, Beijing, China

Due to the high interface/surface-to-volume ratio, interface/surface would play an important role in the mechanical behaviour of nanostructured materials and devices. In the present work, based on the interface/surface elasticity, the authors extended the multiple scattering theory (MST) method for calculating the elastic wave band structure of two dimensional phononic crystals (PCs) with interface/surface stress effect at the nanoscale. The interface/surface elasticity theory is employed to describe the nonclassical boundary conditions at the interface/surface, and the elastic Mie scattering matrix embodying the interface/surface stress effect is derived. Using this extended MST, the authors investigate the interface/surface stress effect on the elastic wave band structure of two-dimensional PCs, which is demonstrated to be significant when the characteristic size reduces to nanometers.

xyswsk@pku.edu.cn

FS06: Fluid structure interactions
09:20–10:20, Tuesday, 21 August
Liqun Chen, China, Chair
Yinlu Young, USA, Chair
Room: 205A+B

09:20–205A+B

Superlyophilic spreading of a droplet on the forest of pillar arrays

Quanzi Yuan†*, Yapu Zhao*

State Key Laboratory of Nonlinear Mechanics, Institute of Mechanics, Chinese Academy of Sciences, Beijing, China

Superlyophilic spreading of a droplet on the forest of pillar arrays was investigated employing a combination method of multiscale experiments and molecular dynamics simulations. The surface topology enhanced its intrinsic wettability, providing excess driving force and making the droplet superwet the surface with higher velocity and smaller equilibrium contact angle. The dynamic wetting process from the precursor film and the precursor chain at the atomic level to the droplet fringe and radius expansion at continuum level was revealed. The physics and mechanism of superwetting were analyzed using molecular kinetic theory. The scaling laws were obtained, and validated by our experiments and simulations. Our results can be a first step in completely understanding the superwetting behaviours and assisting the future design of pillar-arrays in practical applications.

yuanquanzi@lnm.imech.ac.cn

09:40–205A+B

Numerical simulation of fluid-strcture interactions with a direct-forcing fictitious domain method

Zhaosheng Yu†*, Xueming Shao*

State Key Laboratory of Fluid Power Transmission and Control, Department of Mechanics, Zhejiang University, Hangzhou, China

A direct-forcing fictitious domain method is proposed for the simulation of the interactions between fluids and flexible bodies, as an improved version of the Distributed-Lagrange-Multiplier based fictitious domain method previously proposed by Yu. Firstly, it is demonstrated that the Lagrange multiplier problem can be more efficiently solved with a direct-forcing scheme instead of the original Uzawa iterations without the sacrifice of the accuracy. The type of the interpolation function (i.e., smoothed delta function) for the transfer of the quantities between the Eulerian and Lagragian frames is shown not to affect the results significantly. Secondly, the accuracy of the code is verified via test problems. Thirdly, the new fictitious domain method is applied to various problems, including the passive propulsion of a flexible foil in the wake of a *D*-section cylinder, the flapping of a 3D flexible plate in a uniform flow, and the deformation of tri-leaflets at opening stage.

yuzhaosheng@zju.edu.cn

10:00–205A+B

Oblique waves lift the flapping flag

*Jerome Hoepffner**,†*, Yoshitsugu Naka***

**UPMC Univ. Paris 06, UMR 7190, Institut Jean Le Rond d'Alembert, Paris, France*

***Ecole Centrale de Lille, Laboratoire de Mécanique de Lille, Villeneuve d'Ascq, France*

The flapping of the flag is a classical model problem for the understanding of fluid/structure interaction : how does the flat state lose stability? and why do the nonlinear effects induce hysteretic behavior? We show in this letter that in contrast to the commonly studied model, the full three-dimensional flag with gravity has no stationary state whose stability can be formally studied: the waves are oblique and must immediately be of large amplitude. The remarkable structure of these waves result from the interplay of weight, geometry and aerodynamic forces. This pattern is a key element in the force balance which allows the flag to hold and fly in the wind: large amplitude oblique waves are responsible for lift.

jerome.hoepffner@upmc.fr