機械工学セミナー
Mechanical Engineering Seminar

2019年度第3回 (No.18)　2019-No.3 (No.18)

主催：慶應義塾大学理工学部機械工学科
Department of Mechanical Engineering, Keio University

日 時(Date)：
2019年6月26日(水)(June.26, 2019 (Wed.)) 14:45～16:15

場 所(Venue)：
セミナールーム 2 (Seminar Room 2) (14-202)

講演題目(Title)
Multi-scale modelling of emergent dynamic metamaterial behaviour in linear and non-linear regimes

講演者(Speaker)

Varvara Kouznetsova, Associate professor
Department of Mechanical Engineering
Eindhoven University of Technology

Abstract:

Dynamic metamaterials are materials designed for manipulation of elastic waves through specific interactions between propagating mechanical waves and fine scale micro-inertia mechanisms, based on either localized resonance or Bragg scattering, or their combination, leading to exotic emerging phenomena, such as band gaps, negative refraction index etc., opening possibilities for tunable waveguides, adaptive passive vibration control, superdamping, acoustic diodes, cloaking and focussing, noise insulation and (vibro-acoustic) energy harvesting. The development and design of such materials and devices made thereof, requires advanced modelling techniques, capable, on one hand, to deal with complex geometries, boundary conditions and excitations, and on the other hand computationally more efficient than direct numerical simulations.

This talk will present several new multi-scale techniques towards efficient analysis of initial boundary value problems involving dynamic metamaterials. First, a technique specifically developed for locally resonant metamaterials will be discussed. Originating from the classical computational homogenization, well established for quasi-static problems, an extension to transient problems has recently been developed. For linear problems, the static-dynamic decomposition can be used to derive the closed form homogenized equations representing an enriched micromorphic continuum, in which additional kinematic degrees of freedom emerge to account for micro-inertia effects. The application of this approach to metamaterials with negative refraction index and attenuation of flexural vibration of metamaterial beams will be illustrated. In non-linear case, fully coupled two scale transient computational homogenization is used to study the wave dispersion in finite size macroscopic structures, demonstrating various phenomena emerging due to the presence of non-linearities, e.g. amplitude dependent attenuation response, higher-order harmonics generation and energy exchange. Finally, a general homogenization framework towards the computation of complex emergent dispersive elastodynamics will be presented allowing for accurate description of wave dispersion in metamaterials, including multiple high-order branches generated by local resonance and/or Bragg scattering.

お問合せcontact: **杉浦壽彦** Toshihiko Sugiura , Email: sugiura@mech.keio.ac.jp phone: 045-566-1508