הטכניון – מכון טכנולוגי לישראל
הפקולטה להנדסת מכונות

TECHNION – Israel Institute of Technology
Faculty of Mechanical Engineering

SEMINAR - סמינר

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ב' 9.03.15 (יח' באדר, תשע"ה), בבניין דן-קאהן, קומה 0, באודיטוריום 1, שעה 14:30.

יצרה:

Prof. J. D. Goddard
Department of Mechanical and Aerospace Engineering
University of California, San Diego

על הנושא:

Brenner's bivelocity fluid mechanics and gradient effects in general continua

להלן תקציר ההרצאה:

The field *of bivelocity fluid mechanics* represents one of the notable contributions to the impressive scientific legacy of Professor Howard Brenner[1]. Dating approximately from 2004, Brenner authored or co-authored some two dozen papers on the possible breakdown of the Navier Stokes/Fourier models of momentum and heat transport in fluids, a body of work that is often cited in the literature on statistical and continuum mechanics. Central to Brenner's work is the notion that the *barycentric* velocity, which appears in the inertial terms in the Navier Stokes equations, differs generally from the velocity involved in the viscous stress, denoted variously by Brenner as "volume" or "work" velocity. In his subsequent constitutive modeling he assumes that the difference between these two velocities, a "diffuse volume flux", depends on gradients in temperature and density, leading to stress and heat flux in non-homogeneous fluids that differ from the classical Navier Stokes/Fourier models.

The present talk, based heavily on a previous publication by the present author *(Int. J. Eng. Sci.* 48 1279-88, 2010), shows that the work of Brenner poses a challenge to certain continuum-mechanical notions of material points and velocities. However, it is also shown that the bivelocity model is subsumed in a more general framework of higher-gradient models of continuous media that reflect the breakdown of the (Coleman-Noll) "simple material". Within the more general framework, linear constitutive models represent weak non-locality in space as an expansion in the spatial wave number or *Knudsen number* and weak non-locality in time as an expansion in the temporal frequency or *Deborah number* (of Markus Reiner).

As an example, it will also be shown that the general theory gives a more comprehensive model of acoustic wave propagation than the bivelocity model explored by Davis and Brenner (*J. Acoustic Soc. Am. 32,* 2964-68, 2012), the former yielding inter alia Maxwell-Cattaneo relaxation of stress and heat flux. This is illustrated by a comparison of the general model with the bivelocity model to terms of Burnett order in the Chapman-Enskog kinetic theory of non-uniform gases for low-frequency waves with negligible molecular relaxation.

[1] deceased, February 17, 2014

בברכה,

פרופ'/א אמיר שמ
מרכז הסמינרים

המארח: פרופ"מ גל שמואל