MIDWEST MECHANICS SEMINAR

SPEAKER: Professor Eliot Fried
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TOPIC: STABILITY OF A THIN ELASTIC FILM
CLOSE TO A RIGID PLATE

DATE: Tuesday, April 3, 2012
TIME: 3:30 p.m.
PLACE: 138 DeBartolo Hall

ABSTRACT
We introduce and study a variational model for the formation of patterns induced by bringing the surface of a rigid plate into contact proximity with the surface of a polymeric film strongly bonded to a substrate. We treat the film as a homogeneous, isotropic, hyperelastic solid and account for both attractive and repulsive van der Waals interactions between the film surface and the proximate contractor. Aside from confirming the intuitive expectation that the presence of a repulsive contribution to the van der Waals potential should stabilize patterns that form on the film surface, we elucidate the role of repulsive interactions at the onset of instability. For a recently proposed van der Waals potential involving two parameters, the Hamaker constant \( A \) and the equilibrium spacing \( d_c \), our results include estimates for the critical gap \( d_c \) at which undulations appear on the film surface, the corresponding wavenumber \( k_c \), of the undulations, and a lower bound \( f \) for the attractive force needed to induce the undulations. To leading order, \( d_c \sim (A \mu)^n \), \( k_c \sim 1/h \), and \( f_c \sim (\mu A \mu^2 \mu^2)^n \), where \( h \) and \( \mu \) denote the thickness and infinitesimal shear modulus of the film. Correction terms due to repulsive interactions indicate that, while \( k_c \) may be influenced by \( \mu \) and \( A \), \( d_c \) may also be influenced by \( d_c \). Granted knowledge of \( \mu \) and \( A \), our results also suggest a simple experimental protocol for determining \( d_c \).

NOTE: If you are interested in meeting individually with Prof. Fried please contact Evelyn at 631-5431.