

AEROSPACE & MECHANICAL ENGINEERING



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INFORMAL COFFEE PERIOD BEFORE THE SEMINAR IN ROOM 365 FITZPATRICK HALL
UNIVERSITY OF NOTRE DAME, NOTRE DAME, INDIANA 46556

SPEAKER: Professor Jonathan B. Freund
Mechanical Science and Engineering
University of Illinois at Urbana-Champaign
Urbana, Illinois

TOPIC: CELLULAR BLOOD FLOW IN SMALL VESSELS

DATE: Tuesday, January 24, 2012

TIME: 3:30 p.m.

PLACE: 138 DeBartolo Hall

ABSTRACT

The cellular character of blood leads to complex flow phenomenology in vessels that are of comparable size to that of blood cells. We have designed and implemented an advanced algorithm that simultaneously solves for the dynamics of the highly deformable blood cells and their flow in such confined geometries. It is a boundary integral solver, with fast methods for evaluating the hydrodynamic interactions and spherical harmonics for representing cell shapes. The talk will include an outline this method and demonstrations for model configurations. It will then be applied for three studies, which will be briefly summarized. (1) The first is flow in a round vessel. In the tubes and vessels with diameters $D < 8$ microns, red blood cells organize into well-characterized single-file trains. Our simulations are used to investigate flow in a model blood vessel slightly larger than this, $D = 11.3$ microns, for which the cells deviate from this single-file arrangement, deforming continuously and significantly. Conclusions about the cell kinematics in this chaotic dense flow and the formation of near-wall cell-free layers are presented. (2) The second involves the transport of white blood cells, the hydrodynamic margination of which is a central component of the inflammation response. At all the flow rates considered, it is found that the white cell flow predominantly and apparently stably near the wall of the vessel, which is in accord with certain experimental observations. (3) The final brief application will involve the transport of magnetic nanometer-scale particles in small vessels, which can be used for target drug or hyperthermia treatment.

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