THE COLLEGE OF SCIENCES AND MATHEMATICS &
THE R. W. YEAGY COLLOQUIUM PRESENT:

One Biomembrane Problem

by

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MATH BUILDING 357

When lipid molecules are immersed in aqueous environment they spontaneously aggregate into a membrane made up up two mono-molecular layers. The membrane forms an encapsulating bag called vesicle. This happens because lipids consist of a hydrophilic head group and a hydrophobic tail, which isolate itself in the interior of the membrane.

As a first approach, we have studied a model based on geometry assuming that the equilibrium shapes are the minimizers of the Willmore energy under area and volume constraints. Then, the effect of the inside (bulk) fluid is taken into account leading to a more physical dynamics.

A parametric approach is employed, which leads to forth order highly nonlinear PDEs on surfaces and involves large domain deformations. An adaptive finite element method (AFEM), with either piecewise linear or quadratic polynomials, is used for both the geometric and coupled problems. Several computational challenges needed to be addressed and solved.

Time permitting I will also talk about a new paradigm of adaptivity to execute refinement, coarsening, and smoothing of meshes on manifolds with incomplete information about their geometry and yet preserve position and curvature accuracy.

Joint Work with: Andrea Bonito and Ricardo H. Nochetto.