

Idaho State University Department of Mathematics & Statistics

## Colloquium

# Sensitivity in Dynamical Systems

Dr. James Sochacki

Professor

James Madison University



The understanding of dynamical systems – even ones that do not at first seem complicated – requires mathematical analysis, numerical analysis and visual analysis. The latter two have made significant progress because of the advancement in computing and visualization, however, as will be demonstrated these need the mathematical analysis to have meaning. The advancement of science depends strongly on this interaction which includes scientific computing and scientific visualization based on mathematical models that accurately describe the dynamics.

The importance of computing and visualization for the advancement of the understanding of dynamical systems will be presented through six important phenomena. These will be population models (growth and explosion), the mass-spring system, the pendulum system, planar particle dynamics, the single neuron dynamics and the N-body problem of Newtonian dynamics. It will be demonstrated that these systems

have extremely fine characteristics that can only be appreciated through scientific visualization that includes animation. The numerics needed for the animations will be derived using scientific computing which includes parallelization and powerful numerical methods. The numerical methods are based on using polynomial transformations, power series and Cauchy products. Using these, it is possible to address and resolve issues dealing with error analysis, stiffness and robustness across many types of dynamical systems that are modeled by differential equations.

**Friday, October 12, 2018**

**4:00 pm**

**PS 307**

*For colloquium attendees, there will be light refreshments in PS 317 at 3:30 PM.*