

Summer 2019

# Numerical Modeling of a Physical System

Douglas B. Rumbaugh



## Computer and Information Science Undergraduate Project Topics and Ideas

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***Title:***

Numerical Modeling of a Physical System

***Author:***

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***Difficulty:***

Moderate

***Specialization:***

Scientific Computing/Modeling

***If other, please specify:***

***Most Appropriate Course:***

Project I

***Brief Description:***

The student will select a simple physical system (mechanical or thermal) and develop a numerical model of this system using basic techniques, such as Runge-Kutta or Finite-Difference Modeling. Possible systems to consider include: simple cases of fluid flow (Couette Flow, etc.), metal casting, or ballistics. This model can then be applied to solve a specific problem relating to this system. The details of the system, techniques, and specific problem, can be tailored to student interests (within constraints of difficulty).

Requires calculus and limited familiarity with differential equations. This project will not constitute original research, or result in publishable material. It serves to provide an introduction to basic numerical methods.

***Number of students needed:***

1

***Outcomes and Deliverable:***

Mathematical derivations and analysis, the computation model itself, and a report containing the preliminary research, a summary of techniques, and the solution/analysis for the specific assigned problem.

***Skills Required:***

Differential and Integral Calculus, some basic familiarity with the type of system to be examined,

programming ability (Python is preferred)

***Available Resources:***

Doesn't require any specific material resources—a computer with Python and some books for reference material (or the Internet) should be sufficient.

***Program Goal:***

CISC 1.1: Mathematical Analysis, CISC 1.2: Sound Reasoning, CISC 1.3: Develop Solution CISC 4.1: Written Communication, CISC 4.2: Oral Communications

***Student Learning Outcomes:***

1a: The student should be able to analyze a problem in a manner that facilitates the design of its solution., 1b: The student should be able to apply relevant principles of computing during their analysis of a problem., 1c: The student should be able to apply relevant principles of related, non-computing disciplines during their analysis of a problem., 3a: Student will be able write in a standardized format in order to organize their thoughts and deconstruct their ideas at a level appropriate for the desired audience.