

## Abstracts

### VCU-PME Conference, April 21<sup>st</sup> 2012

**11:05-11:20 Speaker:** Cory H. Colbert

**Title:** Algebraic Identities Involving Quadratic Irrationals

**Abstract:** It is a known fact that every natural number can be decomposed into a sum of Fibonacci numbers. Using a special, subtle connection with phi, the Golden Ratio, one can proceed to show that every natural number can be expressed uniquely in terms of powers of phi. We extend this result to more general recurrence relations and exploit the connection between these recurrences and special quadratic irrationals.

**11:20-11:35 Speaker:** Trenicka Kiara Rolle

**Title:** Fluid Structure Interaction within Alveoli

**Abstract:** The alveolar region of the lungs plays the most important role in breathing which is the process of gas exchange. It occurs between the alveolar membrane and the underlying capillaries. During mechanical ventilation, the distribution of forced air within lung parenchyma results in the overdistension of the alveolar wall leading to a cascade of other conditions. These conditions include volutrauma/barotrauma (extreme stress/strain), atelectrauma (repeated opening and closing of collapsed alveoli) and biotrauma. If the aforementioned conditions are increased and worsen multi-system organ failure (MSOF) will occur as a result. This study takes into consideration the fluid structure interaction of the airways in the pulmonary acinus. Although many studies have been done on the alveoli during mechanical ventilation, the methods and models vary. The goal of this study is to pinpoint where the injury begins in order to quantify when that injury becomes life threatening. A finite element model was created and simulations were run using ANSYS software package. The study of this particular structure and the stresses produced can be applied to a tissue model leading ultimately to a study on the microenvironment and how the mechanical properties of the region under extreme stress/strain are affected.

**11:35-11:50 Speaker:** Arqam Ahsan

**Title:** Modeling Criminal Behavior and Crime Dynamics

**Abstract:** Using NetLogo, we will be looking at how crime hot-spots develop in cities. We will look at what parameters cause hot-spots to form and will briefly provide a social explanation for this phenomenon.

**11:50-12:05 Speaker:** Racheal Cooper

**Title:** A Brief Description of a Mathematical Model of the Immune System

**Abstract:** I will explain our mathematical model of the immune system. I will discuss how the equations were derived and validate the model with available data.

**Lunch and Plenary Talk,** Dr. Hill, "*Groups and Games,*" Temple 1165

**2:15-2:30 Speaker:** Sudharshana Srinivasan

**Title:** A list-scheduling based approximation algorithm for the spatial scheduling problem.

**Abstract:** With a limitation of space in large-scale manufacturing industries, the assembly line scheduling needs to consider spatial resources, as well as traditional time restrictions. This requires not only assigning time slots to each job, but also locations and orientations within the limited physical processing space, and ensuring that the locations assigned are the same contiguous units of space throughout the entire duration of processing. Thus, any solution to this spatial scheduling problem (SSP) answers the following two questions:

- When to schedule the jobs?
- Where to schedule the jobs?

List-scheduling is the process of creating an ordering of the jobs (a list) based on some criterion and scheduling the jobs in that order. The goal of this research is to develop an approximation algorithm based on list-scheduling, which would provide a polynomial time sub-optimal approximation for the SSP within an approximation guarantee.

**2:30-2:45 Speaker:** Jiukali Li

**Title:** Cellular Automata Approach to Passivation of Metal

**Abstract:** The topic is a Mathematic Modeling to investigate the Passivation Phenomena of Metal Material.

**2:45-3:00 Speaker:** Matt Parker

**Title:** Commutative Calculus

**Abstract:** It is well-known differentiation commutes with indefinite integration - anti-differentiation - up to some polynomial. We attempt to create a new space isomorphic to that of analytic functions, and an operator on the new space which acts parallel to the differentiation operator, (in that mapping to the new space, applying the operator  $k$  many times, and mapping back is equivalent to differentiating  $k$  times) and commutes with itself; thus, a commutative derivative/antiderivative operator can be achieved by mapping into this new space, applying the new operator to the appropriate degree, and mapping back.

**3:00-3:15 Speaker:** Le Yang

**Title:** A multi-scale model of acute lung injury: role of alveolar type II epithelial cells

**Abstract:** We propose a 2D multi-scale model of acute lung injury, which couples inflammation, type II alveolar epithelial cell (ATII) apoptosis, change of alveolar-capillary interface permeability, tissue damage and repair. The modeling space is a square-shaped alveolar epithelial tissue representing one alveolus. Inflammation, tissue damage and repair are modeled as tissue level events using hybrid ABM strategy. The signaling pathway of inflammation induced and ventilation induced ATII apoptosis was embedded into each ATII cell. The model described how different mechanical ventilation strategies affect inflammatory

cytokines secretion and ATII apoptosis. Simulations under different condition allow us to see different developing patterns of diffuse tissue damage and effort of repair by ATII cells. The outcome of the ongoing pathology is determined by subtle balance between damage and repair. Injurious ventilation strategy and beneficiary (volume control and pressure control) ventilation strategies are compared. The model can be integrated into biomechanical organ model of alveolus and provide a comprehensive modeling platform for investigating different strategies for the treatment of ALI and VILI.

**3:15-3:30 Speaker:** Toni Sorrell

**Title:** What's the Right Number to Fight Crime?

**Abstract:** The police administration is often asked to justify to local governing bodies the size of the police workforce required to meet their performance benchmarks. Previous work relies on queuing models that fail to capture the dynamicity of the policing system. A simulation model is developed to assess the effects of different staffing arrangements on benchmark goals and evaluate the relative difficulty in meeting these benchmarks. Our model uses actual computer aided dispatch (CAD) data to help the police department estimate the number of patrol officers needed to fully staff the patrol force.

**3:30-3:45 Speaker:** James Lee

**Title:** Riffle Shuffle

**Abstract:** The riffle shuffle is the most commonly used method of shuffling cards. In this presentation, we set up a mathematical model by observing and explaining a card "trick." After defining and exploring the aspect of rising sequences in permutations, we will identify the minimum number of times a deck of cards must be shuffled in order for the deck to be truly randomized.

**4:00- Plenary Talk,** Dr. Ermentrout, "*From Toilets to Mexican Hats: A Tour of Biological Patterns,*" Temple 1165