George Rublein
College of William and Mary
Departament of Mathematics
College of William and Mary
Williamsburg, VA, 23187-8795
gtrubl@math.wm.edu

Thermodynamics in beginning multivariable calculus

We discuss the role of elementary differential forms as
path integrands in thermodynamics. Included is an introduction to the vocabulary of the subject as that vocabulary might be reflected in differential specifications for the paths.

Jennifer Webb
Hood College
2365 Route 94
Woodbine, Md 21797
JWpickle@aol.com

The Mathematician who Sold his Soul to the Devil: Gerbert

This May 2003, marks the 1000 anniversary of the death of Gerbert, the French mathematician who became pope. Gerbert made substantial contributions in the tenth century not only in the mathematical community, but also in the political and religious realms. Yet, there are still many uncertainties surrounding his life. For instance, it is known that he was influenced by Arabic works in mathematics, but the question of where he learned it is unanswerable at this point in time. Finally, there exist numerous legends about Gerbert and his work that are both surprising and interesting.

Jonathan Stephenson
Wesleyan College
Virginia

Visualizing basins of attractions

Let $w = f(z)$ be a complex-valued function. Let α be a root of f, i.e. $f(\alpha) = 0$. For each z C, we form the sequence $z_0, z_1, z_2, \ldots, z_n, \ldots$. Where $z_0 = z$ and z_n is the n^{th} iterate of z under Newton's Method. That is $z_n = z_{n-1} - \dfrac{f(z_{n-1})}{f'(z_{n-1})}$, n=1, 2…. The set B_α, then, is defined as $B_\alpha = \{z \;\; \mathrm{C} : \lim_{n\to\infty} z_n = \alpha\}$, and is called the basin of attraction of the root α.

My independent research project is to write a program that plots the basins of attraction using Newton's Method for finding roots. Basin of attraction plotters have been written before but with the limitation of only being able to handle equations of the form $z^n \pm 1$. My intention is to include an equation editor, such that any complex polynomial of the form $\sum_{i=0}^{n} c_i z^i$ may be entered and processed. I will include a zoom function to explore smaller sections of a plot and the fractal behaviors associated with zooming. I also intend to include an automatic color determination algorithm based on Euler's formulas, $z = re^{i\theta} = r\cos\theta + ir\sin\theta$, to choose the color of the root, thus allowing the upper power of the polynomial to be very big. An optimization function will also be included to determine the best view of the picture since the possibility of more elaborate functions of z means that the best view may not be predictable before the equation is processed.

Verne Leininger
Bridgewater College
402 E. College St.
Bridgewater, VA 22812
vleining@bridgewater.edu

The Game of Oktagon: Linear Algebra Gone Bad

In analyzing the freeware game of Octagon, a matrix equation is solved. However the elements of the matrix are from a ring with zero dividers. This leads to results which are different than those learned in a standard linear algebra course.

Bonita V. Saunders
National Institute of Standards and Technology
100 Bureau Drive, Stop 8910
Gaithersburg, MD 20899-8910
bonita.saunders@nist.gov

3D Graphics on the World Wide Web: An Update of Visualizations for the NIST Digital Library of Mathematical Functions

This talk will provide an update on the visualization work being done for the NIST Digital Library of Mathematical Functions (DLMF) Project, a large scale project to update and disseminate the National Bureau of Standards Handbook of Mathematical Functions on the World Wide Web. A key component of the DLMF will be dynamic 3D visualization capabilities that allow a user to interactively examine the unique features of complicated mathematical functions. The latest visualizations completed to date will be presented and discussed.

Paul Warne
Department of Mathematics and Statistics, James Madison University
MSC 7806
Harrisonburg, VA 22801

warnepg@math.jmu.edu

A Priori Error Estimates for Maclaurin Series Approximations to Solutions of Differential Systems

The error bound in the standard Maclaurin series approximation to the solution of the differential system, , typically depends on high order derivatives of , contrasted with the error bound of the Picard approximation to the solution, which depends nicely only on the Lipschitz number for . However, with each successive iteration, the Picard approximation often both expands dramatically in number of terms and requires potentially nontrivial integrations. This talk highlights the development of an error bound, based on the Modified Picard Method, for Maclaurin series approximations to solutions of a wide class of systems, that depends only on the Lipschitz number and a bound on the coefficients of the system.

G. Edgar Parker
James Madison University
Harrisonburg, VA 22807
parkerge@jmu.edu

Power Series as Alternatives to Newton's Method

For any real analytic function which is projectively polynomial (a class that includes the polynomials themselves and the elementary functions of calculus) and not a constant function, any local inverse is also projectively polynomial. This gives us computational access to the power series for any local inverse. In this talk we show how to construct its MacLaurin series, how to use it as an equation-solving device, and compare it qualitatively with Newton's Method.

James Sochacki
Department of Mathematics and Statistics
James Madison University
Harrisonburg, VA 22801
jim@math.jmu.edu

Newton's Method as an Initial Value Ordinary Differential Equation with Picard's Method

Newton's method is an iterative technique for determining an approximation to the root of a differentiable function f(x). It can also be considered as the Euler method approximation to the initial value ordinary differential equation $x'(t)=-f(x(t))/f'(x(t))$. We look at numerical solutions to the initial value ordinary differential equation $x'(t)=-a(x(t))f(x(t));x(0)=w$ using various functions a and Picard's method to obtain the roots of f.

Martin Bartelt
Christopher Newport University
1 University Place
Newport News, Va. 23606
mbartlet@pcs.cnu.edu

Digital Filters and Uniform Approximation

The talk describes what a digital filter is. Then it is shown how a digital filter problem gives rise to a problem in the uniform (Chebyshev) approximation of functions.

Dipa Choudhury
Loyola College
Baltimore, Md 21210
dsc@loyola.edu

Isotropic vectors and coneigenvalues

A vector x is called isotropic if $x^t x = 0$. If $Ax = \lambda \bar{x}$ then λ is called a coneigenvalue of A and x is called a coneigenvector. A complex symmetric matrix S can be expressed as $U \Lambda U^T$ where U is a unitary matrix. Hence a complex symmetric matrix has a set of n independent coneigenvectors. Here we discuss canonical form of complex symmetric matrix in the context of isotropic vectors and coneigenvalues.

Laura Spielman
Virginia Tech
Mathematics Department
Virginia Tech
460 McBryde Hall
Blacksburg, VA 24061
spielman@vt.edu

"The Mathematical Development of Prospective Elementary Teachers"

Two sections of a mathematics course for prospective elementary teachers were administered in the fall of 2002, using different curricula and teaching approaches. This session addresses prospective teachers' mathematical understandings, their course perceptions, and their changing beliefs regarding textbooks, teaching, and learning. Potential implications for undergraduate mathematics are explored.

Reza Sarhangi
Mathematics Department, Towson University
8000 York Road, Towson, MD 21252

rsarhangi@towson.edu

Star Polygons in Geometry and Art, and the Geometer's Sketchpad

Designs that are generated based on regular polygons are good tools for introducing many ideas in mathematics. These designs can be used to study groups and the arts of other cultures. The studies and applications of designs and patterns enrich mathematics and help advance other disciplines such as anthropology; symmetry classifications of bodies of data from ethnographic groups have revealed that cultural groups have preferential ways of arranging design elements.

Parviz Khalili
Christopher Newport University
Dept. of Mathematics
Christopher Newport University
1 University Place
Newport News, VA 23608
pkhalili@pcs.cnu.edu

Six ways to solve cubic equations

In this talk we summarize almost all possible methods of solving cubic equations
x^3 + a*x^2 + b*x +c =0, a,b,c,are real numbers.
We also present a brief historical background of cubic equations.
Finally we propose a "new" method of solving cubic equations.

Bill Wardlaw
U. S. Naval Academy
Mathematics Department
Annapolis, MD 21402
wpw@usna.edu

Accumulation Points of the Set of Totient Ratios

The talk will demonstrate the derived set S' of all accumulation points of the set S = {phi(n)/n : n a positive integer}, where phi(n) is the Euler totient function. If time permits, will also show that the sum of all prime reciprocals, sum(1/p : p a positive integer prime), is divergent.

Hongwei Chen
Christopher Newport University
Department of Math,
Christopher Newport University
Newport News, VA 23606
hchen@pcs.cnu.edu

On a Trigonometric Sum --- A Case Study for Undergraduate Research in Math

In this talk, by studying a trigonometric sum, we demonstrate that Mathematical research can start with generalizing an existing result and lead to quite a different problem of independent interest.

George DeRise
Thomas Nelson Community College
Hampton, VA 23670
gderise@cox.net

Monstrous Moonshine" Why is 196,884 approx=196,883?

The mysterious "Monstrous Moonshine Conjecture" maps modular functions to the Monster Group.This mathematical madness got Richard Borcherds the Fields Medal. This lecture will be an attempt at an intuitive explanation.

Dan Kalman
American University
4400 Massachusetts Avenue NW, Washington DC, 20016
kalman@american.edu

The Pythagonacci Family Reunion

Did you know that Pythagorean Triples and Fibonacci Numbers are connected? Any four consecutive Fibonacci numbers can be combined to create a Pythagorean Triple. This fact also generalizes on both the Fibonacci side and the Pythagorean side. But is the entire idea just silly? Hear the facts, then YOU decide.

Majid Masso
Bioinformatics and Computational Biology, School of Computational Sciences, George Mason University
8068 Stonewall Brigade Ct. #201
Manassas, VA 20109
mmasso@gmu.edu

A Statistical Geometry Approach to the Study of Protein Structure

The genes found within an organism's DNA provide a blueprint for constructing proteins, the workhorse molecules that actually engage in biological function (hormones, receptors, enzymes, structural, regulatory, etc...). A technique from computational geometry, namely Delaunay tessellation, is applied to protein structure and yields a 4-body statistical potential function. Using this approach, total protein potentials and 3D-1D potential profiles are obtained for studying the relationship between protein structure and function.

Guy T. Hogan* and Shadana Yates**
Norfolk State University
Norfolk, VA 23504
gthogan@nsu.edu

Automorphisms of Finite Groups

It is fairly straightforward to describe the automorphism group of an elementary abelian p-group, G. It is just the group of non-singular n-by-n matrices over the field of p elements, viz., Z_p (the integers, mod p), where n is the rank of G. Since information about the structure of its group of automorphisms often reveals much about the structure of the target group, we ask whether any finite group could admit the elementary abelian p-group (p an odd prime) of rank 2 as its full group of automorphisms. In this preliminary work, we show that this is not possible.

Boyd Coan
Norfolk State University
700 Park Avenue
Norfolk, Va 23504

How to teach the Division Algorithm in Pre-Calculus Mathematics and Beyond

Teaching commutative algebra to undergraduates at institutions with highly innovative mathematics programs is not a new endeavor. One can find the essence of a good model for this in the text by Cox, “Ideals, Varieties, and Algorithms”. This talk will be centered on how to introduce a more diverse population of undergraduates to some areas of commutative algebra. Some minor aspects of computational commutative algebra will be mentioned and should be of value to engineering, computer science and mathematics oriented audiences. If time permits, the research topics involving exterior algebra will be mentioned also.

Ezra Brown
Virginia Tech
Math Department, Virginia Tech, Blacksburg VA 24061-0123
brown@math.vt.edu

The Fabulous (11,5,2) Biplane

Begin with the first six digits of pi...they all belong to the set {1,3,4,5,9}...this set has a striking arithmetical property mod 11...which leads to a collection of eleven 5-element subsets of the integers mod 11...we call this collection the (11,5,2) biplane B...turns out that B has lots of symmetry...studying this symmetry produces an intriguing picture...and finally, the biplane has connections with perfect error-correcting codes, combinatorial designs with huge symmetry, and some finite simple groups.