



# VIRGINIA MOUNTAIN SECTION NEWSLETTER

IEEE Region 3, Council 09, Section 65

February 2004

February 19, Clarion Hotel Roanoke Airport

## Student Paper Contest

Presentation of Papers by Undergraduate Students  
from VMI and Virginia Tech on

*Medical Internet-Aware Refrigerator, Growth of Thin Film Alumina Nanospores*

*Spectral Representation of Piecewise Continuous Signals, Firefighting Robot*

### Autonomous Fire-Fighting Vehicle

*E.P.Cooper\*, W-H Jeng, C.B. Johnson,  
J. B. Puvogel, M. R. Shealy, D. J. Smit,  
J. L. Wright\*, M. R. York*

Our team was tasked with designing and constructing an autonomous vehicle that could find a lighted candle placed somewhere in a maze, and put it out. The end result would be a robot that could compete at Trinity College in Hartford, Connecticut in April. The scope of the design included knowledge of the social, political, ethical, and economic impacts of such a device, as well as a design that meets the regulations of the Trinity competition. The robot is built around the Handy Board, which is interfaced to ultrasonic and infrared sensors as well as encoders to control the vehicle's movement. The fire-fighting element of the vehicle is a fan, which is switched on when flame is sensed.

*\*Presented by VMI Seniors Ed Cooper, from Greenville, Ohio and Josh Wright, from Harpswell, Maine*

### Medical Internet-Aware Refrigerator

*Matthew York\*, Thomas A. Largin\*, Paul A. Kuwik, and Dennis J. Crump*

The Medical Internet-Aware Refrigerator is designed for use by an elderly diabetic patient who lives alone and is at-risk for both power outages to their home, and more seriously, personal injury. The central part of the project is a small refrigerator that works using solid-state Peltier junctions. A sensor monitors usage, and if the refrigerator door is not opened in a 16-hour period an embedded microcontroller connected to a modem will send an email alert to the physician. An integrated battery-backup automatically takes over if the AC power fails, using a relay to bring the battery online. The refrigerator has already been through a design review with a physician, and a second review with the physician and patient is planned in the near future.

*\*Presented by VMI students Matthew York, a Senior from Blackstone, Virginia and Tom Largin, a Junior from Clifton, New Jersey.*

### Reservations

Date: Thursday February 19, 2004  
Social: 6:30 PM  
Dinner: 7:00 PM  
Talks: 8:00 PM  
Cost: Member or Guest \$15.00  
Student \$ 8.00

Reserve by **5 PM Monday** Feb. 16  
**Cy Harbourt (540) 387-8941**

<mailto:cdharbourt@ieee.org>

Please specify number of attendees.

### Directions to

#### Clarion Hotel Roanoke Airport

2727 Ferndale Drive NW  
I581 Exit 3 Hersberger Rd West  
1st Rt. onto Ordway Drive,  
¼ mile, Rt. Into Parking Lot.

Please mark the date and plan on coming. Learn about interesting student projects and undergraduate research at VMI and Virginia Tech.

See following page for additional abstracts, and notice of other events.

## Non-Oscillatory Spectral Reconstruction of Piecewise Continuous Signals

**Firmin Ndegés**

The Gibbs' phenomena occurs in Fourier approximation of piecewise continuous functions. This can lead to a number of practical difficulties including poor convergence behavior in approximations to nonlinear partial differential equations. A remedy for the Gibbs phenomena was posed by Cai, Gottlieb and Shu (Essentially Non-Oscillatory Spectral Fourier Methods for Shock Wave Calculations). In their paper, they show that adding a discontinuous function to the standard trigonometric basis functions can mitigate the highly oscillatory  $O(1)$  phenomenon. We extend this method for the case of multiple discontinuities. We begin by detailing an algorithm for selecting the appropriate basis functions to add to the (finite) trigonometric set using only Fourier coefficients of the discontinuous function. We then numerically validate our results for the case of two and three discontinuities. Mathematical analysis that verifies our computed results is included. We then look at more practical issues, such as the sensitivity of our procedure to the magnitude and spacing of discontinuities. Both numerical experimentation and supporting mathematical analysis are presented.

*Firmin Ndegés is a senior at Virginia Tech pursuing concurrently degrees in Electrical Engineering and in Applied Computational Mathematics. He is currently President of the African Student Association of Virginia Tech, is a Student Member of IEEE, and was the 2001-2002 President of the Virginia Tech Student Branch of the IEEE Communications and Network Society. During his college years, Ndegés has worked for various Engineering companies, including Com-Net Ericsson Critical Radio Systems and Georgia Pacific; both located in Lynchburg, Virginia.*

## Growth of Thin Film Alumina Nanopores on Si Substrates

**Ajay Bhatia**

Procedures for the growth of alumina nanopores on Si substrates were developed as part of a research project to fabricate solid state gas sensors for high temperature application. A  $0.2 \mu\text{m}$  film was evaporated onto the surface of the Si wafer using an e-beam evaporator, and oxidized in a phosphoric acid solution. The initial attempts were met with limited success due to a competing process in which exposed Si was attacked, undercutting the aluminum/ alumina film. An additional concern was related to flaking of the aluminum film during the oxidation procedure. Refinements were made including a modification of the evaporation technique, and the use of a barrier layer between the Al film and the Si substrate to promote adhesion. Variations in nanopore structures, sizes, and depths were observed. The use of barrier layers needs further study to provide consistent results that are repeatable.

*Ajay Bhatia is an Electrical Engineering Senior at Virginia Tech. He is from Herndon, VA and has particular interest in microcontrollers.*

### IEEE Leadership Workshop:

Saturday, February 28, 2004  
10:00 a.m. - 5:00 p.m.

Dominion, Innsbrook Technical Center,  
5000 Dominion Blvd. Glen Allen, VA  
23060

Details can be found on the Virginia Council web site at

<http://ewh.ieee.org/r3/vc/>

The Section has agreed to reimburse travel for a car pool of local members interested in attending.

### VMS March Meeting

Thursday March 18  
Spouses Night  
Speaker on Digital photography

## VMS OFFICERS

**Chairman: J. Shawn Addington**  
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**Awards: Open**  
**Membership Development: Open**

## NEWSLETTER

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<http://www.ewh.ieee.org/r3/virginia-mountain>

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