



VMI Department of APPLIED MATHEMATICS

Summer 2012

Special Points of Interest:

- AMICS split
- New Faculty in Applied Math
- AM graduates
- REMACS
- MACSPY

Please Visit the Department on the web at

<http://www.vmi.edu/macs>

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MACS to split into two departments

As of May 2012, the MACS department will divide into two departments. LTC Troy Siemers will continue as head of the department of Applied Mathematics, while COL Myke Gluck will become the interim head of the new program.

The Applied Mathematics (AM) degree will continue to focus on the three main areas of operations research, statistics, and numerical methods, emphasizing modeling, simulation, and computational methods applied to real-world problems.

We describe many new AM initiatives and programs throughout this newsletter.

The aspects of the degree replacing computer science (to be named) will still focus on computing, but increase emphasis on cybersecurity, information technology, database management and communication networks. The new program is scheduled to begin Fall 2013.

For more details on either program, visit our webpage or contact LTC Siemers or COL Gluck.

APEX Text for the Calculus Sequence

Starting in Fall 2012, the MA123-124-215 calculus sequence will be taught from an e-text developed by the Applied Mathematics department's Affordable Print and Electronic teXtbook (APEX) consortium. LTC Greg Hartman, who was awarded a VMI Jackson-Hope New Directions in Teaching and Research grant, was the primary author and directed the effort in the creation of the text.

The department created the APEX consortium several years ago in an effort to provide free electronic texts coupled with inexpensive print versions not only to give students a break from the high cost of the texts, but to also keep creative control in the hands of the authors. The consortium also includes collaborators from other Virginia colleges and universities in the consortium. For this partic-

ular text, LTC Troy Siemers and Dr. Brian Heinold (Mount Saint Mary's College) contributed sections and Dr. Jen Bowen (College of Wooster) edited the entire text.

In creating the text for the calculus sequence, LTC Hartman developed the entire framework and layout using LaTeX. The text uses the Creative Commons licensing so that anyone who wishes to use or alter the material can do so (as long as the work is not then sold).

The calculus text joins LTC Hartman's *Fundamentals of Matrix Algebra* APEX text used in VMI's MA103 course and LTC Siemers's *An Introduction to Matlab and Mathcad* APEX text used in VMI's MA110 course. In the long run, it is a goal of the department to have APEX texts developed and used in as many courses as possible.

The department on Facebook:
Search for: VMI Department of Applied Mathematics and Computer Science



Applied Mathematics Graduates

Seven Applied Mathematics cadets graduated as part of the class of 2012.

Ryan Schaedel graduated with honors as a double major in Applied Mathematics and Physics. He commissioned as an Ensign in the Navy and will go to Charleston for Nuclear Power School.

Alex Hufnagel commissioned as a

2nd Lieutenant in the US Army and will go to Fort Benning, GA as an infantry officer.

Cheng-Wei "Vincent" Kuo was a distinguished graduate. He commissioned as Ensign in the Republic of China Army.

Chung-Yen Yang was a distinguished graduate. He commissioned as Ensign in the Republic

of China Army.

Taeseung Kwon will be returning to his native Korea and will pursue career options in diplomacy.

Anderson Caldwell will join the Center for Army Analysis at Fort Belvoir, VA.

Felix Kitur is planning to run for

Department Awards and New Plaques

The department annually presents four awards.

Due to the generosity of the Virginia Division of the Daughters of the Confederacy, the Knox family, and the French medal fund, we will be displaying plaques in the mathematics department listing the descriptions of the awards as well as the winners of the awards since

1985, the date of inception of the Knox and Fontaine Maury Awards.

Cadet Vincent Kuo '12 was the recipient of both the Commodore Matthew Fontaine Maury Award as the first standing graduate in mathematics and the John H. French Medal as the member of the graduating class who has shown the greatest ability in mathematics.

Cadet Cameron Armstrong '14 received the Colonel Robert H. Knox Prize as the member of the third class who is the most promising mathematics major in his class.

Cadet James Snyder '13 won the Baldwin Alexander and Steven Taylor Pendleton Scholarship as the most promising member of the rising first class math majors.

MAJ John David and Cadet Will Lucas in SURI

This summer Maj John David will work with cadet Will Lucas during SURI 2012. Their project will involve applying neural networks to statistical data from major league baseball.

MAJ David has a long track record of working with students at the College

of Wooster on similar work in neural networks with other sports data.

Cadet Lucas, a member of the VMI football team, shares MAJ David's interest in exploring the mathematics behind sports statistics and has gotten a good jump on the project with preliminary research.

As part of the SURI framework, the project will result in a paper and poster presentation. The poster will be presented at the VMI Undergraduate Research Symposium as well as at the Mathematical Association of America's section meeting that VMI will host in Fall 2012.

Future Conferences

This fall, the Applied Mathematics department will host the Mathematical Association of America's (MAA) MD\VA\DC sectional meeting. The department is very active in the section as CMDR Dan Joseph is the current section chair. CMDR Joseph and MAJ Nate Axvig will be coordinating the meeting to be held October 27-28, 2012.

CMDR Joseph was also instrumental in procuring VMI's hosting of the Virginia State Science and Engineering Fair (VSSEF). This fair will bring talented high school students to Post to display their science and engineering projects.

VMI will also be hosting the first of three conferences to focus on STEM education. This first conference in October 2012 will feature Dr. Neil deGrasse Tyson and will focus on

mathematics education. Several members of the Applied Mathematics department have worked with the STEM planning group.

VMI also hosted the MAA American Mathematics Competitions for 10th and 12th graders. We will continue to host these and will add the 8th grade competition in the coming year.

Alumni Survey and News

In spring 2012, the department conducted two alumni surveys, one for 2007-2011 graduates (“recent alumni”) and 2003-2006 (“old corps”). The response was excellent, with an 85% return rate of those contacted (thank you FB), indicating a strong connection to the “mother I”.

Of the respondents, 45% are on active duty holding positions like Navigator\Flight commander, Nuclear Submarine Officer, Surface Warfare Officer, Signals Intelligence Officer, and C4ISR Analyst.

Others are working in industry and government with titles such as Operation Research Analyst, Data Analyst\Modeler, Special Investigator, and Mathematics Teacher.

Alumni are working in all branches of the military as well as for companies like the Center for Army Analysis, the John’s Hopkins Applied Physics Lab, Freddie Mac, Kinsale Insurance, ENERActive Solutions LLC, Medical University of South Carolina, Pioneering Evolution LLC, Warren & Sinkler LLP, and the Vestavia Hills and Henrico County school systems.

Alumni have attended a wide range of graduate schools for Masters de-

grees, an MBA, a JD, and a PhD in fields such as mathematics, mathematics education, statistics, intelligence studies, operations research, law, mental health counseling, aerospace science, physics, biology, systems engineering, geospatial intelligence, and fluid dynamics.

The graduate schools included the University of Richmond, the American Military University, Johns Hopkins University, Liberty University, Manhattanville College, the College of William & Mary, George Mason University, Walden University, the Naval Post Graduate School, the University of South Carolina, Hampton University, the University of Virginia, the Naval War College, the University of Alabama Birmingham, Harvard University, the College of Charleston, and Duke University.

The attributes of VMI that alumni found beneficial include small classes, accessibility of faculty members, the overall structure and required time-management.

Many alumni have kept current in their field through a combination of attending conferences, reading books and articles, and taking classes, both in person and online.

The results were overall positive and even the answers to the least useful parts of the program suggested only omissions in the program such as not having a senior thesis (which we now do), more emphasis on real-world scenarios (see the REMACS article), more computer modeling (see the new courses article) and a desire to have more statistics and large-data-set techniques (we’ll work on it!). Some suggested additional oral and written work requirements—hopefully we’ve answered that in the new capstone course (see the MA490W article). Overall, we’d say that the Applied Mathematics program should have been put in place long ago!

As far as specific aspects of the program, Calculus, Operations Research, Probability, and Statistics were all seen as essential by a large majority of alumni.

We hope to continue the communication lines with our alumni! If any of you are interested in getting more involved with the department, giving a talk to current and future cadets, visiting the department, being part of the VMI Career Service’s video “alumni vignettes” please let us know. Best of luck for the future!



The Open Math Lab (OML) started Fall 2011 as part of the Mathematics Education and Resource Center (MERC), led by director MAJ Randy Cone.

The OML provides free tutoring to cadets in 100-level mathematics courses Mon-Thurs, 1800-2300 in Carroll Hall.

www.vmi.edu/merc

New Faculty

It has been a while since the last news letter, so I wanted to get you caught up on the new faculty (since fall 2008).

MAJ Meagan Herald joined the department in 2008 with her PhD from the University of Utah in Biomathematics. She works closely with the Cystic Fibrosis community on research on mathematical models of respiratory infections and mathematical models of biofilm formation. At VMI, she is a tireless member of several committees, including the postwide STEM committee. For the past two summers, she has acted as the main counselor for the MACSPY summer camp, a camp designed for high school students interested in majoring in AM, CS or PY at VMI.

MAJ Nate Axvig joined the department in 2010 with his PhD from the University of Nebraska—Lincoln. His research work is in Coding Theory and simulation. At VMI, he is the coordinator for the MA105-106 statistics sequence and a member of

the postwide Institute Honors committee. Most recently, he took a group of 12 cadets to West Point for participation in the Military Operations Research conference and student problem competition (in which the cadets did well). He is a new member of the MAA's Project NExT program.

MAJ Randy Cone joined the department in 2010 with his PhD from Virginia Tech. He has been active in many areas at including getting VMI to host the Mathematical Association of America's American Mathematics Competition for 8th, 10th, and 12th grade students. He is also a new member of the MAA's Project NExT program. MAJ Cone is the first director of the new Mathematics Education and Research Center (MERC) - see the article in this newsletter for details. He is a new member of the MAA's Project NExT program.

Maj Geoffrey Cox joined the department in 2010 with his PhD from the University of California—Irvine in

Biomathematics. At VMI, he is the advisor for the Phi Eta Sigma, a member of the STEM committee and the committee for deciding postwide awards for faculty, and is a faculty advisor for the club soccer team. He is a new member of the MAA's Project NExT program.

MAJ John David joined the department in 2011 with his PhD from North Carolina State University. He previously worked at the MIT Lincoln Labs and did a post-doc at the College of Wooster. During the summer of 2012, he will be involved in the new REMACS program (see later article for details).

MAJ Dimplekumar "Dimple" Chalishajar joined the department in 2011. He had previously taught at VMI as an adjunct faculty member and as a tutor for the two years prior. He is a very active researcher in the field of Control Theory, having published many papers in prestigious journals. He is also the editor for three professional journals.

New and redesigned Courses

During the past few years, the department has introduced new courses and revamped others in order to fit the Applied Mathematics emphasis.

Piloted in fall 2011, MA310: Matlab Programming, will become a permanent part of the AM curriculum. In the course, we study advanced Matlab functionality, geometric techniques (Monte Carlo, random walks, and Levy Flights), and the brute force, nearest neighbor, simulated annealing, and genetic algorithms applied to the Traveling Salesman Problem (TSP). The course concludes with the development of a

TSP graphical user interface (GUI) that integrates these algorithms.

MA472: Non-Linear Optimization is an elective course that is a continuation of MA 319 to include a review of linear programming using the Simplex Method & LINDO software; review of multi-variable calculus topics; and a survey of various techniques for optimizing functions that are not in the realm of linear programming. Introduction to the Kuhn-Tucker conditions for optimality. Techniques include branch and bound for integer programming and search methods for quadratic pro-

gramming and other non-linear problems.

MA470: Chaos and Non-Linear Dynamics gave an introduction to the mathematics of nonlinear dynamics of 1-dimensional and 2-dimensional models including: Fixed points, Linearization, Stability, Bifurcations (Saddle Node, Transcritical, Pitchfork and Hopf), Limit Cycles, Hysteresis, Strange Attractors, Liapunov Exponents and Fractals.

The MA326-405 Prob\Stat sequence, now a requirement for AM majors, will include more technology, including the programming language R (mentioned in several of the alumni surveys).

REMACS 2012

Beginning in summer 2012, the Applied Mathematics department will begin the REMACS program.

Standing for Research Experiences in Mathematics and Computer Science and organized & primarily run by MAJ John David, the program's focus is to work with industry on real world problems using modeling, simulation, and other mathematical tools. Each project will involve 1 faculty and 1 to 3 cadets.

In just the first year, we have arranged 4 projects involving cadets Cameron Armstrong (a double AM\PY major), Alex Falcetti, Ryan Harner, Stephen Mascioli (a double AM\ME major), Steven States, Chap Michie and members of the

AM faculty including MAJ David, MAJ Geoffrey Cox and MAJ Nate Axvig. We will also have two Rockbridge HS seniors participating in the program.

The projects:

The first is with the John's Hopkins Applied Physics Laboratories (APL) and will investigate ways of determining sufficient levels of Navy assets for piracy detection off the West Coast of Africa.

The second project is with the local Valley Program for Aging Services. Currently the program spends more than \$200,000 on gas in delivering over 700 meals a day.

The team will work on determining optimal routes for the delivering the meals.

The third is with the City of Lexington. The team will work on the creation of a digital database to determine the city's energy usage.

The final project is with the VMI Mathematics Resource and Education Center (MERC), where a team will develop teaching materials for use by tutors in the 100-level mathematics courses.

In early fall 2012, we will have a day of presentations for the VMI community and potential collaborators from industry.

MA490W and MCM Competition

The Applied Mathematics capstone course, MA490W, required for AM majors underwent a major change for fall 2011. Due to the increased sizes of the senior classes, one-on-one cadet-faculty senior projects were replaced with a group-based approach focusing on preparation for the international Mathematics Competition in Modeling (MCM).

Cadets, working in teams of three, used the fall 2011 semester to study previous models and MCM problems such as the battle of Trafalgar, an efficient gasoline purchasing model and a fingerprint classification scheme.

In February 2012, the cadets competed in the actual MCM competition that included 3,697 teams from 17 countries. This year's problem asked for a design of how to manage camping and boating trips on a 225 mile river given restrictions such as number of boats allowed, camp sites available, and length of stay.

VMI had three teams in the competition with seniors Alex Hufnagel '12, Taeseung Kwon '12, and Chun Liu '12 earning an impressive "honorable mention" commendation for their solution.

The teams of Felix Kitur '12, Cheng-Wei Kuo '12, and Chung-Yen Yang '12 and another of Anderson Caldwell '12, Narathip Khanhansuk '12, and Jacob MacIntyre '12 both earned "successful participant" commendations.

The cadets presented their posters at the VMI Undergraduate Research Symposium (URS) in April 2012. See the June 2012 VMI Institute Report for a related article.

You can also visit the MCM site for the previous contests and read the actual 2012 contest problem at:

<http://www.comap.com/undergraduate/contests/mcm/contests/2012/problems/>



COL Francis Mallory
(Taken 1939)



Applied Mathematics Class of 2012

From left:

Felix Kitur,
Cheng-Wei Kuo,
Jacob MacIntyre
Chung-Yen Yang,
Alex Hufnagel
Taeseung Kwon,
Anderson Caldwell

Not pictured:
Ryan Schaedel

News from LTC Troy Siemers, Head of Applied Mathematics

Greetings from the Applied Mathematics Department! As you can see from the articles in this newsletter, the program is doing well.

We have been able to recruit great Applied Mathematics faculty, adding 6 new faculty members in the past four years. The cadet classes have continued to grow as well with eight 2012 graduates as well as FILL IN in the classes of 2013 and 2014. The incoming class this year has 9 members, but if history is a guide, that will grow over the 4 years.

The MA-CS-PY summer camp for high school juniors and seniors is now in its third year and has also grown from 16 to 21 students. The incoming class of 2016 will have several members of last summer's MACSPY program. A big thanks to MAJ Herald and COL Baker for their year to year efforts with the camp!

Within the department we have a great community and have celebrated with a fall football tailgate, a big Christmas party, and a fun picnic at MAJ David's house, where once again the cadets got to learn from the faculty just how you play ultimate Frisbee.

Postwide, the Applied Mathematics department is involved in many areas. The new Mathematics Education and Resource Center is a long overdue addition to VMI as we try and educate and retain students in the STEM disciplines. In the first year, the MERC was well used by cadets and in a short amount of time it will outgrow its small space in Carroll Hall and need to expand (of course, on the crowded Post "to where?" is the key question!).

We are showing great leadership through securing the Virginia State Science and Engineering Fair and hosting the fall MD-VA-DC section

meeting of the Mathematical Association of America. Both are great efforts by CMDR Joseph (with key help from MAJ Axvig of course!).

The new Research Experiences in Mathematics and Computer Science program, initiated and coordinated by MAJ David, will go a long way to answer the question "just what can you do with a math degree?" The real-world projects with industry will showcase the strengths of an AM education and will benefit our majors, our faculty, VMI, and the mathematics community.

I thank all of the alumni who replied to the surveys, the response was overwhelming. Your feedback is appreciated and will help in improving the program in the future!

Sincerely,
LTC Troy Siemers

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