

## 2016 Virginia Outstanding Faculty Awards

<b>1. <u>NAME</u></b> Full (Legal): John A. David <span style="float: right;">Preferred First Name: John</span>	
<b>2. <u>INSTITUTIONAL INFORMATION</u></b>  Institution: Virginia Military Institute  Rank/Position Title: Assistant Professor  Year Rank/Title Attained: 2011  Years at Institution: 4  Campus Email Address: davidja@vmi.edu  Campus Phone: 540-464-7489  Campus Mailing Address: 430 Mallory Hall, VMI, Lexington VA 24450  Campus Communications Contact: -Name: COL Steward MacInnis -E-mail: macinnissd@vmi.edu	<b>3. <u>PROFESSIONAL INFORMATION</u></b>  Academic Discipline: Applied Mathematics  Specialization/Field: Modeling, Computation  Type of Terminal Degree: PhD  Year Awarded: 2007  Awarding Institution: North Carolina State University
<b>4. <u>PERSONAL INFORMATION</u></b>	

**Please check only one box:**

- RESEARCH/DOCTORAL INSTITUTION NOMINEE:
- MASTERS/COMPREHENSIVE INSTITUTION NOMINEE:
- BACCALAUREATE INSTITUTION NOMINEE:
- TWO-YEAR INSTITUTION NOMINEE:
- RISING STAR NOMINEE:

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Signature (President or Chief Academic Officer) _____	
Printed Name: <u>Bg. Gen. Jeffrey G. Smith</u>	
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## Mission Statement

Established by the Virginia General Assembly in 1839, the Virginia Military Institute is a four-year, wholly undergraduate, state-supported college whose student body is organized as a military corps.

## The VMI Mission

**The Virginia Military Institute believes that the measure of a college lies in the quality and performance of its graduates and their contributions to society. Therefore, it is the mission of the Virginia Military Institute to produce educated, honorable men and women, prepared for the varied work of civil life, imbued with love of learning, confident in the functions and attitudes of leadership, possessing a high sense of public service, advocates of the American Democracy and free enterprise system, and ready as citizen-soldiers to defend their country in time of national peril.**

To accomplish this result, the Virginia Military Institute shall provide to qualified young men and women undergraduate education of highest quality—embracing engineering, science, and the arts—conducted in, and facilitated by, the unique VMI system of military discipline.

## Summary of Accomplishments

### Teaching

Dr. David has developed a track record of engaging students in undergraduate research, industrial consulting, and independent studies that few professors, particularly those at the assistant professor level, can match. Since 2005, when as a graduate student he was given the opportunity to mentor a student through a program to advance under-represented groups in science and engineering, **he has mentored 61 students in summer to year-long projects**, an average of **6.1 per year**. Since joining the full time faculty of Virginia Military Institute (VMI) this effort has only increased with an average of **7 per year**. These projects have engaged students in a broad number of areas in science, engineering, and business.

In addition Dr. David has **taught an incredible breadth of courses in the applied mathematics** curriculum, including all levels of the calculus and pre-calculus sequence, probability, statistics, mathematical modeling, numerical analysis, and differential equations. Few math professors teach such a variety of material, particularly those at the assistant professor level.

Even while teaching in many new areas Dr. David has been described as an excellent teacher, as can be seen in many of his anonymous student evaluations.

- One of the best teachers I have had, my favorite class
- By far the best professor I've had at VMI. I've been in 3 of his classes now and every time I've enjoyed his lectures. Always willing to help, even if it's inconvenient for him. Take him if you can
- Was enthusiastic about the material which makes learning easier
- He really knew what he was talking about.
- He kept the class awake somehow: very uncommon
- He's a kid at heart and the best professor I've had at VMI
- Our final project helped me see how practical statistical analysis can be
- His attitude is great and he's good at passing knowledge on
- Did a great job teaching a hard subject, he explains things in a very easy to understand way. He cared and was clearly interested in students' success
- Explains things very clearly and is very knowledgeable. Keeps the class interesting... Great teacher. Always helped me, I really appreciate it
- Always available for help even on the basketball court
- Loves his job and explains everything very well, don't change a thing
- Genuinely cared about our success, was always there to personally help if needed
- Brought a positive attitude every day and created a comfortable learning environment
- He's good at explaining tough topics and always makes sure everyone understands
- Project (was the most intellectually stimulating) because it let us use what we learned in a real world application
- Managed to make prob/stat interesting which is an accomplishment
- Excellent teacher, knows his stuff, best class of the semester for me
- Kept the course moving to maintain interest, but encouraged questions and explained as long as it took for someone to understand
- Labs were a good practical application, connects lessons to real-world applications
- Placed a significant amount of autonomy in my hands when working on the project, which allowed me to really immerse myself in the work.

- Lives for teaching, great guy and class! MAJ David is the bomb
- Very relatable and friendly, great teacher and is by far my new favorite teacher for math!
- Applications of what we were studying was awesome, gave examples of how topics were used in jobs, he did awesome
- You can tell he enjoys teaching which makes it easier
- Explained everything well and showed a lot of examples and possible applications
- Great mentor, found the balance between helping me when I needed it but also knowing this was independent study and let me do my own thing
- Very helpful, good tutor outside of class, very encouraging
- Very understanding, stays on subject until class is prepared to move on
- Always available to help, knows how to guide you to an answer rather than giving it
- This course was the most intellectually stimulating course of my cadetship
- Very smart and super enthusiastic about the material
- I really enjoyed the project-style tests in computing. Very useful skills learned
- He is very personable and holds us to a high standard that I enjoy
- Project allowed us to take something we wanted to study and build our own model

In recent years VMI has sought to reduce the emphasis on quantitative metrics of teaching and no longer records or compares these statistics. As Dr. David values quantitative analysis he has personally tracked these metrics since starting at VMI. **In all quantitative evaluation questions Dr. David has received a median score of 5 out of 5 in every course he has ever taught at VMI.**

Beyond being an outstanding mentor and classroom teacher, Dr. David has been innovative in teaching applied mathematics and quantitative analysis. In 2014 **he developed an entirely new course in mathematical modeling. This course offered students the opportunity to apply mathematics to real physical systems and work with real experimental data they collected themselves.** Very few math courses do this and even fewer do it at the undergraduate level. It is a game-changing opportunity for VMI students to get the real world scientific and computational skills to lead in today's military and workforce.

In addition to his innovation within the Applied Mathematics Department, Dr. David is currently working with VMI's Economics and Business Department to **develop a minor in Business Analytics**, one of the fastest growing and highest demand areas in today's workforce. MIT recently held a symposium in which "a distinguished group of financial and industry executives... discussed the shortage of data savvy professionals." [web link: MIT Analytics Meeting](#)

### Discovery

A dedicated teacher at one of the best liberal arts colleges in the nation, Dr. David has already made outstanding contributions to science and engineering. In his young career he has **published 11 peer reviewed articles, 9 conference proceedings, had 8 news articles written about his work, and given dozens of conference and invited talks.**

He recently signed his **first book publishing contract** with Lexington Books for *Predicting Conflict: A Multi-method Approach*. This book takes hundreds of quantitative and qualitative descriptors of each country for the last 70 years and describes how to apply cutting edge data mining and machine learning techniques to predict international conflict. It is one of the most data and computationally intensive studies in the area to date. It has the potential to change how policy makers understand and intervene in international conflict.

Dr. David was also a **co-inventor on a device that many in the scientific and engineering world thought was impossible** (<https://sciences.ncsu.edu/news/origin-story/>). Along with a team of industrial physicists, engineers, academic mathematicians, and many undergraduates, he successfully modeled a doubly-compressed, multiple beam klystron, a device that could power the next generation of particle accelerators. This work was invited to be presented at the Cern Large Hadron Collider in Europe in 2013, the laboratory where the famed Higgs Boson particle was discovered in 2012. It is now a part of the plan for designing the world's next major accelerator system.

Dr. David's specialties include mathematical modeling and computation with a strong emphasis on interdisciplinary applications, including physics, electrical engineering, medicine, toxicology, sports, and economics. These skills have enabled him to work on a **remarkably diverse and relevant set of problems**.

- Modeling and population analysis of the soy protein Genistein
- Modeling, clinical trial design and control of HIV infection and treatment
- Optimization of electron gun design
- Modeling of chemical contamination of a subway system
- Counter jamming techniques for USAF systems
- Probability models for gene motifs
- Agent based models for animal flocking behavior
- Computational control of nonlinear integro-differential systems
- Parameter optimization for Phenomenological model of stochastic, spatiotemporal, intensity dynamics of stimulated Brillouin scattering in a two-mode optical fiber
- Machine learning techniques for real interest rate prediction
- Machine learning techniques for prediction of football, baseball and basketball games
- NFL QB rating techniques
- Machine learning techniques for international conflict

These diverse projects have given Dr. David extensive experience working with scientists and engineers in many disciplines. These experiences have pushed him to develop extensive mathematical and quantitative skills and have given him an abundance of examples to use in any of his courses.

### **Knowledge Integration**

Perhaps Dr. David's biggest contribution to VMI's community and cadets is his integration of industrial mathematics into the cadet's education through **the creation and direction of the Applied and Industrial Mathematics (AIM) program**.

This program gives VMI cadets experience in the practical applications of applied mathematics and computer science which the classroom cannot provide. For five-ten weeks of the summer, student teams and faculty advisors from VMI are joined with a (usually local) business, industry, or government agency (client). This partnership is beneficial to all involved. The student participants are exposed to the practical applications of mathematics and computer science in a "real world" setting and acquire knowledge which will aid them in their senior capstone project, and later in life, including contact with potential employers.

In addition, the cadets get the opportunity to work with scientists and clients in a multi-disciplinary setting, a skill that is becoming invaluable in today's scientific and industrial workplace. The faculty advisors have the opportunity to be involved with a very select group of

students in a summer activity, while contributing to research in the fields of applied mathematics and computer science. Clients have the opportunity to tangibly support education and, at a low cost, obtain solutions to problems that would most likely not be addressed internally. Clients also get the opportunity to see first-hand the caliber of VMI cadets which is an opportunity for the clients to recruit talented potential employees.

The structure of the program is based upon several research teams which work independently on separate projects, but also come together for discussion of progress. These teams are comprised of students (usually two-three) and a faculty advisor. The faculty advisor involvement is heavy initially as the student team becomes familiar with the project definition. After approximately two weeks, involvement becomes primarily advisory as the students work directly with client representatives and others. Student teams give weekly progress reports in the form of oral presentations, in addition to periodic presentations to their respective clients. Each team also gives a final oral presentation and written report to the client upon completion of the project. **Virginia Living has recently chosen to highlight this program in their State of Education Issue.**

One of the wonderful consequences of developing the AIM program is the number of opportunities it has given young faculty members to be paid to mentor students in real world projects. Since starting at VMI, this program has given five other young assistant professors, the opportunity to engage in this type of mentorship, opportunities they would not have had without Dr. David's creation of this program.

**Through AIM and in other venues, Dr. David has mentored students in a large and diverse number of problems:**

- Predicting tire rubber performance using neural networks for the Goodyear Tire Company. An algorithm newly used by their Research and Development team before any potential rubber compounds are synthesized.
- Optimizing production for a steel wire manufacturer. Manufacturing processes and staffing levels were changed in line with student recommendations.
- Transforming 2d microscopy images into 3d representations for the Goodyear Tire Company. This piece of software is now commonly used in their rubber imaging work.
- Building software to design search routes for piracy detection for John Hopkins University Applied Physics Laboratory. This software was used in an analysis presented to their US Navy sponsors.
- Using genetic algorithms to find optimal meal delivery routes for the Valley Program for Aging Services Meals on Wheels Program. For the past four years thousands of meals have been delivered in an optimal manner based on this software. An article on this project and the entire AIM program was recently published [web link: AIM and Meal Routing](#)
- Developing a data base to track energy usage for the City of Lexington. All buildings owned by the city now have their energy usage tracked by software designed by a cadet after his first year at VMI. The previous method involved pen and paper. [web link: Energy Hogs](#)
- Creating a database to track community needs for the United Way of Greater Augusta. This database has been used to receive significant funding for local community development processes.
- Optimizing process for Vector Industries, a non-profit that employs handicapped individuals. **This project significantly reduced the time spent on logistics and data management issues and allows them to focus on their primary mission "To**

**operate a successful business that employs and trains persons with diverse disabilities and to enable them to reach their potential as productive community members.”** [web link: From Hours to Minutes](#)

- Creating algorithms to detect shipping errors for a local manufacturer. The local production facility ships millions of dollars of products a year and had an error rate much higher than other locations within the national company. Our algorithm helped them predict the probability that a particular order would have an error and helped them determine the orders to be inspected again.
- Developing software to identify the most cost effective orders to fill for a local manufacturer. The work was featured in the company newsletter.
- Analyzing thirteen years of ticket sales and donor records to help manage the American Shakespeare Center. The center’s director said of the project “It’s going to help us target our marketing in a much better way rather than just making queries, we have all of this data we don’t have the time or expertise to dig into. They helped us make sense of all of our data.” [web link: Shakespeare and Math](#)
- Understanding the quantitative tradeoffs of opening a second distribution facility for Laser Tag Source a national laser tag rental company. The project identified a way to increase profits by 14% and a second facility will be opened early next year. The owner of the company said of the project “We were shocked to find out how much we could save by opening a second location... Joe (the cadet researcher) exceeded our expectations and I was very impressed with his work.” [web link: Laser Tag](#)

These real world opportunities have revolutionized how VMI cadets view applied mathematics and have **opened the doors to amazing professional opportunities for them.** The list of places AIM alumni and a few other former cadets who worked closely with Dr. David have taken jobs, graduate school appointments, and internships is impressive, including: **John Hopkins Applied Physics Laboratory (2 cadets), Massachusetts Institute of Technology Lincoln Laboratory, Center for Army Analysis (2 cadets), Dell Computers, NASA, Coca-Cola, JP Morgan, Syscon North America, Deloitte, Raytheon, Financial Risk Group, US Army (3 cadets).**

### Service

Dr. David’s service is an **outstanding example of how to implement and innovate within programs to make those around him better, such as:**

- Starting the “research/teaching speed dating” workshop at VMI to introduce faculty to potential collaborators from other departments.
- Creating the STEM Roundtable speaker series an opportunity for all STEM and STEM-interested faculty to share research, programs and pedagogical work with the VMI community. This program specifically works to integrate new VMI faculty in the research and teaching culture.
- Co-organizing the Math in Sports session of the Joint Mathematics Meeting (largest US math meeting), which gives faculty and especially students, the opportunity to present work in one of the most exciting ways to encourage young people to study mathematics.
- Serving on the Graduate Relations Committee, managing programs which facilitate our students pursuing advanced degrees.
- Serving on the Undergraduate Research Committee, working to implement the vision and logistics necessary to this very important part of VMI’s educational mission.

- Serving as a judge for the Moody Mathematics Modeling contest for high school students. This is one of the largest applied mathematics contests in the world and an amazing tool to encourage students to pursue applied mathematics and modeling.
- Serving on multiple job panels for students and graduate students pursuing jobs in applied and industrial mathematics. His experience on both the industrial and academic side of this world makes him an outstanding resource for young science and engineering students.
- Performing dozens of interviews to hire three outstanding young professors of applied mathematics in his own department. In many ways there is no better way to improve your own students than to do everything possible to hire other outstanding faculty members. **The Dean remarked after this year's hiring how important Dr. David's work and programs were in recruiting talented young applied mathematicians and faculty in other disciplines.**
- Undertaking a large quantitative study of the VMI academic program. He has combined and analyzed an extensive data set of faculty workload, departmental retention, adjunct usage and salary related issues. This work will be used to allow VMI to most efficiently and effectively train and teach our students.
- Organizing external showcase days for his students' industrial math projects. This program showed potential sponsors, the local community and VMI students and faculty the potential of this type of work.
- Serving on a committee to determine whether offering online courses is consistent with the VMI educational mission. This involved a significant amount of research on these types of programs at dozens of institutions and led to many interesting conversations with educators across the nation.
- Serving on the national Modeling across the Curriculum meeting (through the Society for Industrial and Applied Mathematics and other national and statistical organizations). This involved multiple national meetings to develop techniques and approaches to integrate mathematical modeling into the K12 through college curriculum. The report for this program can be found here [web link: Modeling Report](#).
- Co-leading a workshop at the national meeting for the National Society for Experiential Learning on developing consulting and internship type experiences within the academic setting.
- Co-leading a workshop for all VMI summer undergraduate researchers on how to apply their work and academic abilities particularly as to how it can be done within an industrial consulting role.
- Co-leading a panel working to encourage and support VMI faculty in doing undergraduate research.
- Co-leading a reading group for cadets with a faculty member in the History Department on the writings of C.S. Lewis.
- Serving on the newly formed VMI Committee on Enhanced Learning Environments. The goal of this committee is to advise the Dean and recommend programs that meet strategic needs and foster innovations to enhance teaching and learning across the academic program.

## Personal Statement

What really transformed school and learning from something I did because I was expected to into something I got excited about was the opportunity to apply what I learned in a classroom to a real problem. At twenty-two, my first internship was at a toxicology laboratory. I was completely out of my area being the only mathematician at the lab. I didn't know how to work a microscope or how proteins affected the body or virtually anything else they were working on. The weekly seminars at the lab could have been in a foreign language and I wouldn't have known it. The problem I was assigned to didn't have a clear answer; a huge part of our work was just figuring out what the question was. The data was noisy, with many mysterious omissions, and there was no "back of the book" answer for me to see if my work was correct. I did, however, have good mathematical training skills that no one else in the lab had. After getting up to speed on the basics of the problem I was able to take these mathematical skills, some basic biological principles, and some real test data, and help them understand how this protein was going to affect a large group of people in an entirely new way.

This experience was an absolute game-changer for me. Being able to go into a completely foreign environment and use the skills I had spent years developing to make an impact on a real problem had me hooked. Now, I've spent the last 13 years doing dozens of problems like that first one. Looking back on the opportunities I've had in my young career, I'm amazed at what I've been able to experience. I've done everything from working to improve highly classified USAF systems, to spending a week in the DC metro area developing and testing mathematical models for biochemical attacks, to helping the local senior center use genetic algorithms to better deliver hot meals to their elderly clients. Being able to use math, data, programming, statistics, modeling and other scientific and engineering skills to make the world around me better is an absolute joy.

After several years of working as an industrial mathematician, I enjoyed what I did but felt I could have a larger impact by training young people to do this kind of work. I can solve a few problems or have an impact in a few areas, but giving a large group of students the skills and experience to improve the world around them has a near limitless potential. I believe we can train the next generation of problem solvers through two primary methods. The first is to bring as many real problems into the classroom as possible. The second is to get as many students as possible out into the community solving real problems.

Bringing more realistic problems into the classroom is significantly harder than doing traditional book problems, both for the students and teachers. It would make my life a lot easier to simply do the same calculus exercises students have been doing for generations and check them against a well-worn solution manual or even easier pose these as multiple choice questions and check them by a computer. However, again and again former students talk about the impact more realistic problems have on their ability to succeed in the workplace and in life. Not only are these problems valuable in training, they also spur real excitement about mathematical education. One of my students built a model to predict the number of points players would score in a fantasy football league. His excitement when he was able to outperform the ESPN predictions was infectious to the entire class. I had to stop the questions from the class during his presentation and then had many students stay around after class to talk even more about the model. Needless to say the Fundamental Theorem of Calculus rarely elicits such a reaction.

There are many approaches I use to infuse more realistic problems into the classroom but I will focus on the mathematical modeling laboratory we built here at VMI. Many mathematical curricula do little more than pay lip service to applications. Some are increasingly incorporating applications but rarely go beyond existing models that only exist on a chalkboard. In our

program we work to take our students through the entire process of applying mathematics to real systems. First we look at the underlying physical laws that govern a system. Most math classes would stop here. Then we show how computers can give us solutions that traditional pencil and paper methods cannot. Again and again I hear former students and employers talk about the need to be able to compute the solutions to real problems. In what I feel is maybe the best part of this course, we then go to the laboratory and run the experiments. We can then compare the results of our mathematical model to the real data. I specifically design the problem so that even if they do everything correctly their model will do a very poor job of approximating the data. This forces them to think about the physical assumptions they made when building the model and in turn to change their assumptions to build better models that more accurately capture the world around us.

The second primary way I seek to train the next generation of problem solvers is by getting them out in the community solving problems for businesses, government, and non-profits. The more realistic problems, such as modeling fantasy football or heat propagation, are wonderful tools and experiences like these enabled me to move into the workplace but there is no substitute for a problem that improves your local community. I've been blessed to have a department and institute that has supported me in engaging the local community. During work time (and after) I have met with multiple chambers of commerce, industrial forums, United Way staff, Rotary clubs, alumni groups and many others. During these opportunities I cannot only hear and understand the problems and needs around us but talk about how we can engage our students in solving these problems. A wonderful example of this was our project with the local Meals on Wheels Program. Our local chamber of commerce director put me in touch with their director so I drove to her office and she began to describe to me their delivery process of having multiple drivers deliver hot meals to a changing lineup of clients within a short period of time. At one point she says "at times the drivers pass each other and wave to each other, I know this can't be the best way to do it." I smiled and said "no ma'am but I've got a young person who can find the best way." That summer one of our students, along with help from a local high school intern, built a piece of easily updatable software that they can run each time their drivers or meal recipients change, to use a genetic algorithm to find the optimal route for each of their drivers to take. Three years later they still use this software each day, and that young man was able to publish a paper on the project and now serves his country as a Second Lieutenant in the US Army.

I've been blessed to have a wonderfully fulfilling career using mathematics to improve the world around me. Now I am blessed to give my students this same opportunity through incorporating more realistic problems into the classroom and bringing our students to problems in the local community.

## Abbreviated Curriculum Vitae John David

### Education

North Carolina State University (winner of 2010 AMS Award for Exemplary Program)

- *Ph.D., Applied Mathematics*, December 2007. Advisor: Hien T. Tran.
- *M.S., Applied Mathematics*, December 2004.

University of North Carolina at Chapel Hill.

- *B.S., Mathematics*, May 2002. Minor: *English*.

### Professional Experience

- *Assistant Professor, Virginia Military Institute* (2011-Present).
- *Post-Doctoral Researcher, The College of Wooster* (2009-2011).
- *Technical Staff, MIT-LL Advanced System Concepts Group* (2007-2009).

### Selected Publications (Refereed Journals) red denotes undergraduate authors/inventors

- **Falcetti, A.**, Axvig, N., David, J. *Optimal Meal Delivery Through the use of Genetic Algorithms*, accepted Problems, Resources, and Issues in Mathematics Undergraduate Studies: Vol. 2, Iss. 7, 2015.
- **Armstrong, Cameron**, David, J., Thompson, J. *Phenomenological model of stochastic, spatiotemporal, intensity dynamics of stimulated Brillouin scattering in a two-mode optical fiber*. *Opt. Express* 23(14), 17866-17882 (2015).
- **Taylor, R.**, (advised by David, J.), *Strange and Chaotic Attractors, SIAM Undergraduate Research Online*: Vol 4, 2011.
- David, J., Pasteur, D., **Janning, M., Mohammed, S.** *NFL Game Winner Prediction through the use of Artificial Neural Networks, Journal for Quantitative Analysis in Sports*: Vol. 7: Iss. 2, Article 9, 2011.
- Ives, L., Attarian, A., Bui, T., Read, M., David, J., Tran, H., **Tallis, W., Davis, S., Gadson, S., Blach, N., Brown, D., Kiley, E.** *Computational Design of Asymmetric Electron Beam Devices*. *IEEE Trans. on Electron Devices*, Vol 56, No. 5, 2009, 753-761.

### Selected Conferences Proceedings

- **Michie, R.**, David, J. Basuchoudhary A. *Patience and “Good” Institutions: Predicting Real Interest Rates and Institutional Quality* 2014 US Public Choice Society Meetings.
- **Steinhour, R., Snyder, B., Thomas, H.**, Burkhart, C., Papakonstantopoulos, G., Byrnes, D., David, J., *3-D Sample Reconstruction from 2-D Electron Microscopy Images*, Proceedings of the Midstates Conference on Undergraduate Research on Computer Science and Mathematics, 2011.
- **Blaikie, A. Abud, G.**, David, J., Pasteur, D. *NFL and American College Football Game Winner Prediction and Statistical Analysis through the use of Artificial Neural Networks*, Proceedings of the Midstates Conference on Undergraduate Research on Computer Science and Mathematics, 2011.

### Selected News Releases

- Cadet Takes AIM on Laser Tag: Summer Program Uses Math to Solve Problems for Online Rental Company [web link: Laser Tag](#).
- Applying Math – To Shakespeare: AIM Summer Program Gives Theater a Helping Hand [web link: Shakespeare and Math](#).
- From Hours to Minutes: Cadet Project Automates Tasks for Waynesboro Non-Profit [web link: From Hours to Minutes](#).

- *Cadet Intern Uses Math to Root Out City Energy Hogs.* Mary Price. August 2012. VMI Institute Report. [web link: Energy Hogs.](#)

### **Patent**

- Electron Gun for a Multiple Beam Klystron with Magnetic Compression of the Electron Beams. R.L. Ives, H.T. Tran, T. Bui, A. Attarian, **W. Tallis**, J. David, **V. Forstall**, **C. Andujar**, **N. Blach**, **D. Brown**, **S. Gadson**, **E. Kiley**, M. Read. Awarded Oct. 2013.

### **Selected Presentations and Advised Presentations**

- 2014, Plenary Speaker, VMI STEM Conference, Lexington VA.
- 2013, Invited Speaker at Staunton Rotary Club Luncheon (including 1 student speaker).
- 2013, Big South Undergraduate Research Conference, High Point University (2 students).
- 2013, Greater Augusta Regional Chamber of Commerce Industrial Roundtable, (included 3 students presenting 2 projects) Staunton VA.
- 2012, VMI STEM Education Conference, Lexington VA. (included 2 students presenting 2 projects).
- 2012, VMI AIM Day, Lexington VA (included 5 students presenting 4 projects and 4 posters).
- 2012 Quadrennial Physics Conference (student presented poster) Orlando FL.
- 2012 Joint Mathematics Meeting (student presented poster) San Diego CA.
- 2012, SIAM Conference on the Life Sciences, San Diego, CA.
- 2012, Joint Mathematics Presentation (advised student Andrew Blaikie gave a talk in the MAA session for math in sports).

### **Selected Funding (total 21 awards, \$132,940 since 2009)**

- 2015 VMI SURI Program for project "NCAA Sports Prediction through Adaptive Neural Inferential Systems" (\$7,716, 1 student, 1 faculty summer support).
- 2015 Laser Tag Source "Equipment Distribution Analysis" (\$3,985, 1 student summer support, 1 faculty support).
- 2014 American Shakespeare Center for project "Data Analysis for Improved Center Operation" (\$3,985, 1 student summer support, 1 faculty support).
- 2014 Davidson and Gerrard Investment Firm for project "Data Analysis for Portfolio Optimization" (\$3,985, 1 student summer support, 1 faculty support).
- 2013 Vector Industries for project "Optimization of Vector Industries Data Processes" (\$3,985, 1 student summer support, 1 faculty support).
- 2013 United Way of the Greater Augusta Region for project "Database Creation and Analysis on Community Needs of the Greater Augusta Region" (\$4,351, 1 student summer support, 1 faculty support).
- 2012 Johns Hopkins Physics Laboratory for project "Simulation of Piracy Detection Off the Horn of Africa" (\$4,881, 3 student summer support).
- 2012 City of Lexington for project "Development of Data Base Tool for Energy Usage Monitoring" (\$1,627, 1 student summer support).
- 2012 Valley Program for Aging Services for project "Optimal Meal Delivery Software Development" (\$1,627, 1 student summer support).

## Letters of Support (Excerpted)

Dr. John David has almost single-handedly elevated the profile, productivity, and relevance of VMI's already innovative Applied Math department. Dr. David has matched his myriad of outside passions with a once-in-a-generation talent for teaching, problem-solving, and pedagogical invention to transform VMI's math curricula and approach toward student development and community service. Since the advent of Dr. David's wildly popular course on mathematical modeling, the Applied Math minor has grown into VMI's most popular minor, numbering 80 cadets from almost all of VMI's 14 academic departments. Despite the fact that he teaches the broadest portfolio in his department, each course Dr. David has taught has received the top possible quantitative rating. Unprecedented. His students rave about his classroom methodology, which requires each cadet to examine and frame real world problem sets, collect actual data, then build or modify mathematical models to propose solutions. Because most problems sets require a collective team to solve, Dr. David's signature achievement is the establishment of VMI's first-ever applied mathematics internship program, the Applied and Industrial Math program (AIM). Each summer, four to six cadets from Dr. David's program join regional corporations and businesses to help solve their pressing problems. Cadets not only contribute to real world solutions, they form alliances that bond VMI – its cadets, faculty, and graduates—to lasting partnerships across the State. VMI's Superintendent personally tasked Dr. David to build a mathematical model that would optimize faculty workload, student/faculty ratio, and classroom size as preface to future budget proposals. His work promises to break years of administrative deadlock. Because of John David's influence, VMI is producing mathematicians with instincts and the tools to match, and who have already enjoyed problem-solving success in the real world environments. **Brigadier General Jeffrey G. Smith, Jr. US Army (Retired), Deputy Superintendent for Academics and Dean of the Faculty, VMI**

Beginning in 2009, VMI initiated a process to revitalize the Applied Mathematics (AM) degree program. Dr. David joined the VMI faculty in 2011 as a key hire to help us meet that objective. He has exceeded our expectations to become one of the most productive members of our faculty, in any department. His contributions have been instrumental in bringing national recognition to the VMI AM program. One of the more significant among his achievements is the Applied and Industrial Mathematics (AIM) program, which he founded and has developed into a cornerstone of the AM degree. His work has brought mathematics to life for VMI cadets in the AM major – they know the power of mathematics in the global marketplace and how to apply it to solve real-world problems. His record speaks for itself, making it abundantly evident that he is an exceptionally talented teacher and scholar, and that he has brought a high standard of excellence to his work at VMI. **BG Wane Schneiter, Deputy Superintendent for Academics and Dean of the Faculty Emeritus, and Professor of Civil & Environmental Engineering, VMI**

Major David excels in his ability to capture students' attention and direct their energy, enthusiasm, and ambition towards solving a problem ethically, efficiently, and creatively. He ensures they have the foundation of a strong knowledge base, coupled with the curiosity to identify new areas of inquiry, and the confidence to explore them. Moreover, he understands how to secure the administrative, infrastructure, and resource needs necessary to optimize the value and impact of all the classroom, service, work skills, and leadership opportunities he provides for his students. He is a little like Mary Poppins. He can make the tools required to get the job done appear seemingly effortlessly, turn the job into the most densely educational and engaging task possible, and encourage the cadets to move forward on their own when they are ready. I regularly highlight aspects of John's work for other faculty members as great examples

of best practices from which we can all learn. **LTC Megan H. Newman, PhD, Sponsored Programs Administrator, Director, Center for Undergraduate Research, VMI**

I have known John as a colleague on committees, co-author, and as a co-mentor for an undergraduate research project. He brings a “renaissance man” sensibility to the problem at hand in all these settings. By that, I mean he approaches problems from different disciplinary perspectives, undergirded by a firm scientific purpose and a sense of deep humility before knowledge. This approach remains the gold standard for scholarship in particular and that very human ability to wrest knowledge from chaos in general. As a result, I know his students appreciate learning mathematics from him – but most of all they appreciate learning about being human. He has certainly enriched my life. **COL Atin Basuchoudhary, Roberts Professor of Free Enterprise Economics, VMI**

Dr. John David goes above and beyond in his effort to cultivate the ideals of the Virginia Military Institute (VMI) within his students. Our relationship started in the classroom, but I ultimately have come to know him as a trustworthy mentor. This relationship has allowed me to observe the passion that Dr. David brings to practicing the core principles of VMI and inspiring his students to do the same. He truly believes that he is making the world a better place by pushing students to be skillful and honorable leaders. Dr. David is heavily invested in creating opportunities for students that allow them to step into that role and has truly made a difference in how students from VMI place in the workforce. **Chap Michie, Winner of VMI-SIAM award for Best Project in Applied Mathematics 2014, VMI Class of '15, Winner of Best VMI STEM Institute Honors Thesis**

John David is an educator in the word's most honest sense. As my professor, internship leader, and thesis mentor, he constructed an environment each and every day that inspired forward movement on whatever project in which I was engaged. I was never *given* an answer. I was challenged not only to work towards the answer by myself, but to analyze the gaps in my knowledge that could be filled in order to be able to answer similar questions in the future. This continual process of guided self-improvement developed what I consider to be my most valuable habit. It cemented my habit of constant learning, regardless of the situation, and ensured the confidence I have in my ability to teach myself anything (with the right references) if I want or need to do so. This is and will always be invaluable to me. **2LT Cameron Armstrong, US Army, VMI Class of '14, Class Valedictorian**

Major David has given me the tools I need to be successful in life and realize my potential as a person. As his student, he instilled in me a love for learning that has allowed me to achieve more than I ever thought I could in the classroom. Not only did I become a better student because of Major David, he also taught me how to be a productive employee as well. I was fortunate to work with Major David in the AIM program for two summers where I learned the skills, technical and non-technical, necessary to have an immediate impact in the working world. These experiences were the catalyst that put my life on the right track, landing me in the top analytics program in the country, as well as a career that I never thought I would be capable of pursuing. His influence reaches well beyond the classroom and the AIM program. Following Major David's example I have become a more effective leader, a more influential team member, and most importantly a better person. There are very few people, in life or academics, which have the type of positive impact that Major David has on his students and colleagues. **William Lucas, Financial Risk Group, Winner of VMI-SIAM award for Best Project in Applied Mathematics 2013, VMI Class of '14, MS Analytics NC State University**

It is hard to overestimate the impact John has had in his short time at VMI. That he is an exceptional classroom teacher is readily apparent from discussions with his students. However, it is his work outside the classroom that has been the most remarkable to me. Their experience with the AIM project has completely changed numerous VMI cadets' fundamental understanding of the nature of mathematics – inspiring them to not only view mathematics differently but to enthusiastically pursue math related careers. In addition, the AIM project has impacted the community as John and his team members have provided real solutions to real problems encountered by businesses and non-profits alike. It has also provided an avenue for other VMI faculty members to engage with cadets in a mentoring relationship. This is just one way in which he makes those around him better at what they do. Add to this the care John displays in his interaction with cadets in and outside of the classroom and it is clear that Dr. John David is truly a “Rising Star.” **Dr. Daniel Joseph, Associate Professor of Mathematics, Liberty University, VMI Class of '91**

It is an honor for me to be able to speak about John David. My work with John was in collaboration with his role as the Director of the AIM Program. Professor David's commitment not just to his profession, but the mission of the educational institution in which he is a part of, shows in every interaction with him and every action by him. His high sense of public service and free enterprise were the framework for this project. The engagement of his students, empowering them to develop a high level of personal and professional development, that will make them prepared well beyond their peers to enter the workforce. As said by John Quincy Adams: “If your actions inspire others to dream more, learn more, do more and become more you are a leader.” This is Professor John David, he is a leader who has been an inspiration by creating confidence in the function and attitudes to the next generation of leaders. **Cynthia Pritchard, President and CEO United Way of Greater Augusta**

I've had the distinct pleasure of working with John for the past four years as both a sponsor of cadet research and an employer of recent VMI graduates. During that time, I have watched as John worked side-by-side with his cadet charges, mentoring them and stretching them to develop their analytic skills through the use of real-world, operationally-relevant problems. Over that time, I have hired two of John's former students and recently made an offer to one of his current students, a member of the Class of 2016. All three of these gentlemen display a thirst for knowledge and a passion to continue their education that is superior to many of the recent college graduates that I am exposed to. John David is most deserving of the prestigious State Council of Higher Education for Virginia's Outstanding Faculty “Rising Star” Award.” **Jack Keane, Precision Engagement Systems Branch Office, Force Projection Sector, Johns Hopkins University Applied Physics Lab**

A major part of John David's young but already distinguished career as a faculty member is his valuable and tireless preparation of students for the varied roles of interdisciplinary research mathematicians. One specific and novel course development by John David is the experimental teaching module that provides students with truly exciting, engaging learning opportunities that connect mathematics to genuinely meaningful applied problems. His development of this course is expected to significantly transcend the research training of students and will serve as a model to other institutions of higher learning wishing to develop similar curricula. His work on establishing the AIM program at VMI is equally stunning and unparalleled. This kind of interdisciplinary collaboration trains the students not only for academia but also for government scientific labs or industry. This is a remarkable contribution to the scientific enterprise of the world. **Hien Tran, Alumni Distinguished Graduate Professor, Department of Mathematics, North Carolina State University**

## Additional Documentation

**In 2015 USA Today rated VMI the #9 school in the country for getting a Bachelor's Degree in Applied Mathematics.** This is the highest rating for any school in Virginia and ranks above programs at UC Berkeley, Northwestern, and Carnegie Mellon. For a department that had 12 total majors across all four years of students in 2007, this is an amazing recognition—due in no small part to the vibrancy of young faculty like Dr. John David. [web link: USA Today Ranking](#)

John David is admired by his students at VMI due to his teaching and mentoring style. He sparks their interests and then entices them into discovering the underlying mathematical details creating a future generation of mathematicians with the rigor necessary to succeed and the creativity required to solve genuine complex problems. He has a knack for selecting the students who will flourish in a research environment (which is not always the exceptional students one would typically expect) and works tirelessly to provide them with a professional research endeavor. Dr. David gives the students the complementary benefit of serving their community while expanding their erudition. **LTC Megan Herald, Associate Professor of Applied Mathematics, VMI**

Without exaggeration, John David has done the most to support the mission of VMI, and the most to put the word “applied” in our Applied Mathematics Department, as anyone in our department. His AIM program has given students opportunities to face, and to solve, truly real-life problems. The experience gained by our students is invaluable, propelling several into very competitive positions within corporate America and another into graduate school (where this latter student entered VMI to play football, not sure he would even graduate!). John's current accomplishments are impressive, yet he still has plans for growth. He is very deserving of the Rising Star Award. **COL Greg Hartman, Professor of Applied Mathematics VMI**

For four years I have observed in John David the motivation skills reminiscent of Jamie Escalante, the gifted math educator characterized in the movie “Stand and Deliver”. I also liken his teaching techniques to the ingenious talents of the mathematician and author of Innumeracy, John Allen Paulos. The list of accomplishments in graduate school, business, and government of students that John personally mentored is long and impressive by any standard. **COL Lee Dewald, (US Army Retired) Professor of Applied Mathematics VMI**

The Applied and Industrial Mathematics (AIM) program that John David created and passionately operates puts students in excellent positions for success. In only four years, thirteen (and counting) AIM students have gained experience thinking critically, working independently, and solving real world problems. These skills are highly desirable by employers and as such John's AIM students have signed on at top tier graduate programs (Analytics MS at NC State) and private firms (Deloitte Consulting). The VMI mission statement states “that the measure of a college lies in the quality and performance of its graduates” and John David is a rising star whose impact on graduates is setting the high measure mark for VMI. **MAJ Benjamin Grannan, Assistant Professor of Economics & Business, VMI**

MAJ John David has demonstrated an impressive agility in collaborating with faculty and industrial clients in disparate subject areas. His projects have ranged from developing models to predict internal conflict in nations, to models of the stochastic behavior of the interaction of intense laser pulses with acoustic excitations in glass optical fiber. It is the latter project that I approached John about a couple of years ago when we had a very talented double major in applied mathematics and physics who needed a project for his honors thesis. I had recently completed experiments on stochastic intensity dynamics analogous to turbulence that occurred

in the scattering of laser light by acoustic waves in glass. I had completed some preliminary modeling that I wanted to develop more fully. I asked John if he would be interested in helping with the modeling, and he agreed. Thus, we began co-advising an honors student who would end up doing graduate level work under our joint guidance. John's main contribution to this work was his ability to conceive and implement a more sophisticated method of choosing parameter values in nonlinear optics modelling, and this turned out to be a ground-breaking aspect of the project. The end results were a very nice honors thesis for our joint student and a publication in Applied Optics, which has been ranked second among 86 optics journals in total citations. **COL John R. Thompson, Ph.D., Cameron Institute Professor of Physics and Astronomy and Former Department Head, VMI**

Dr. John David exemplifies the VMI mission of producing well-educated graduates who have a high sense of public service, a love of learning, and are prepared for the work of civil life. He uses his background in industry and applied mathematics both in the classroom in the multidisciplinary mathematical modeling course he designed and as director of the summer Applied & Industrial Mathematics (AIM) program, where he has mentored many cadets on solving real-world mathematics problems from clients in industry and government. His students have gone on to do important work at places like NASA, Dell, Center for Army Analysis, MIT, and Johns Hopkins. I highlight one cadet that John inspired in particular who came to VMI with his father's hope that he "just stay eligible for football" and who left VMI and entered to the very strong Master's program at the Institute for Advance Analytics at NC State. The cadets and I hold John in high regard and very much appreciate his devotion to the program and to the institute. **COL Troy Siemers, Department Head and Professor, Applied Mathematics, VMI**

It is my pleasure to address the nomination of MAJ John David as Virginia Military Institute's candidate for the Virginia's Outstanding Faculty 'Rising Star' Award. John is a dedicated educator and researcher. He engages students both in the classroom and in undergraduate research projects. I once overheard one of my department's best students telling others if they have a chance, take courses from MAJ David. John has engaged in cooperative research efforts with many of the faculty. He and I have many mutual research interests and have been able to share information that has allowed us both to progress in our work. I have great respect for what John has been able to do since arriving at the Institute and vigorously support his candidacy for the Rising Star Award." **COL David Livingston, Professor of Electrical Engineering, VMI**

I served as John David's department chair for two years while he was visiting The College of Wooster. John came to us as an experienced and talented researcher who was looking to transition into the world of academia. It was a true pleasure to watch him grow as a teacher and to see his true passion for helping students to shine through. John developed a talent for clear and enthusiastic classroom presentations, and his friendly, approachable personality made him a favorite teacher among students in the department. John directed several undergraduate theses, supervised teams in applied mathematics research projects, and offered a tutorial to one of our most promising students. This particular student produced a fine piece of writing, and claimed that working with John David was one of the highlights of his undergraduate career. We were sorry to see Dr. David leave us, but we knew that he was headed toward a bright future as a teacher and scholar of mathematics. **Dr. Pamela Pierce, Professor and former Department of Mathematics Chair, College of Wooster**

John has exceptional enthusiasm for his students and all aspects of his work as a professor. Every time I see him at a conference, he is trying something new and asking for feedback. His positive approach to work leads to innovation and success. We have had the most interactions with regards to mathematical modeling and industrial mathematics, which he

has infused in his courses and departmental curriculum. He is a most worthy candidate for this award. **Dr. Rachel Levy, Associate Professor of Mathematics and Associate Dean for Faculty Development, Harvey Mudd College Vice President for Education, Society for Industrial and Applied Mathematics (SIAM)**

Drawing on his research experiences both inside and outside of academia, Maj. David prepares cadets to be leaders in this era of data-driven decisions, building skills that apply equally well in military or industrial settings. Through the AIM program that he initiated, he guides cadets in digging deeply into open-ended, real-world problems, which leads naturally to improved communication skills and mastery of key scientific techniques. **Dr. Drew Pasteur, Associate Professor, Department of Mathematics, College of Wooster**

I first met Professor John David when he was a principal leader and a driving force of the Applied Mathematics and Research Experience (AMRE) at The College of Wooster. My company frequently engaged the AMRE program, and I worked closely with John and his teams on a project involving advanced knowledge mining techniques for the prediction of materials properties. His leadership and mentorship of the undergraduate team involved, not only provided concrete results to serve our research interests, but his care and guidance of each member of that team promoted a sense they could do great things. Most of the students that were part of that project went on to graduate school, and indeed greater fulfillment of their dreams. Because of John's active engagement and enthusiasm, we viewed the collaborations as an unqualified success, and he as a gifted mathematician, a true leader, mentor and teacher. **Dr. Craig Burkhart, R&D Associate and Senior Materials Modeling Research Scientist, The Goodyear Tire & Rubber Company.**

Dr. David was an enthusiastic and valued participant in the AMRE program. Dr. David has a very broad knowledge base in applied mathematics and his leadership on the consulting projects was invaluable to the success of the teams. He is an extremely versatile mathematician and this enabled him to adapt his expertise to whatever settings were needed. It is no surprise that he has gone on to develop the AIM program at Virginia Military Institute. **John Ramsay, Professor of Mathematics, Associate Dean of Experiential Learning, Executive Director of Advising, Planning and Experiential Learning Center, College of Wooster**

I first met Maj. John David my freshmen year when he was my Differential Equations professor. I then decided that I wanted him to be my academic advisor for the remainder of my time at VMI. He has helped my academic development immensely over the past year and my course through VMI would have been quite different without him. He has helped me realize the dream I had of graduating a year early with no prior college experience. I have learned from his successes in the greater world of mathematics significantly. Originally, I had not planned on pursuing anything in the field after graduation. I have since learned all the wonderful things a higher education in math could give me. He makes me want to be a better student so that one day I might have as impressive a resume as he does. He has taught and pushed me towards my goals both in and outside the classroom. My future is full of possibilities because of him. I owe him a great deal. **Cadet Connor Loken, VMI Class of '16**

MAJ John David is an outstanding teacher and mentor, with a dedication and sincere interest in his students. Despite having restrictions on students with academics, the military, and extracurricular activities at the Virginia Military Institute, he still found time to mentor and educate students around their schedules. I personally have worked with him on a project for a nonprofit organization creating a mathematical algorithm to optimize routes to over 75 houses

for the elderly. His availability, expertise, and proficiency in mathematics greatly helped me achieve my goal and a working model, which is in the process of being published. **2LT Alexander Falcetti, US Army, VMI Class of '14**

Major John David is one of the most passionate professors I have had the privilege to learn from, both inside and outside of the classroom. Dedicated to his students and especially to their success, Major David has always made a great effort to help each student succeed in his class and at the Institute. His passion and enthusiasm for mathematics, particularly probability and statistics, helps him ease students out of their frustrated or even fearful mindset about how difficult math can be and demonstrate to them how applicable, simple, and useful it really is. Before taking his class, I did not care for probability or statistics, but when Major David took the time to help me fully understand it, it became one of my favorite areas in mathematics. Even after passing his class, he made sure to check in with me to make sure that I was enjoying my time and doing well in my classes. This is one of numerous times in my experience at VMI that Maj David, by taking time out of his schedule and checking in on me, not only fostered my love of learning, (especially of probability and statistics), but also displayed the ideals of service above self that the Virginia Military Institute constantly urges its students to emulate. **Samantha Alpert, Analyst, Systecon North America, VMI Class of '14**

I took multiple classes taught by MAJ David at VMI and additionally he was my faculty advisor on my undergraduate research project. He always showed a passion for teaching but more importantly a passion for his students. I always felt comfortable going to him for help (academically, personally, and professionally) because his door was always open and he never turned down an opportunity to invest in us. My most memorable interactions with MAJ David were at the end of my cadetship working on undergraduate research. When I first met MAJ David he demonstrated a passion for predictive analytics in sports and it was his passion and knowledge of the subject that motivated me (and others before and after me) to pursue a research project in this area. I worked very closely on a daily basis with MAJ David to complete my research and thoroughly enjoyed and benefited from his tutelage and leadership. He demanded quality work, tracked progress, supported the research, and most importantly led by example to motivate me to emulate his work ethic and appetite for constant learning and improvement. MAJ David taught me to have a mindset of never being satisfied and always searching for better answers that I continue to apply in my job today. He is extremely deserving of the Virginia's Outstanding Faculty "Rising Star" award due to his commitment to excellence as both an instructor and leader. **James Snyder, Logistics Analyst, Coca-Cola, VMI Class of '13**

I tell people that the reason I switched majors to Applied Mathematics is largely because of the outstanding faculty. Among them, Dr. David is a prime example. I think the best word to describe Dr. David would be "genuine." It's a simple word that carries a lot of meaning in the context of the student-professor relationship. The Applied and Industrial Mathematics summer program, of which Dr. David is creator, is where I discovered the dedication, clarity, and intelligence that a math professor can have, while simultaneously engaging in such human acts as inviting us to summer cookouts with his family. **Cadet Ryan Poffenbarger, VMI Class of '16**