Keep up with what 's new - Systems Engineering at the Naval Postgraduate School



## SE NEWSLETTER HIGHLIGHTS

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- Monterey Phoenix Analyzer 2.0 Release
- SE Student Research Efforts
- Summer (AY16) Graduation Highlights and Awards
- First Missile Defense Agency Cohort Graduates
- Fall (AY17) Graduation Highlights and Awards
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- Faculty Awards



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## Letter from the Chairman

Systems Engineering as a recognized discipline is fairly new. The professional society INCOSE was formed only in 1990 and the SE Program at NPS was formed in 2002. However, even though it is only recently recognized as a distinct engineering discipline, INCOSE has grown rapidly with over 10,000 members and the NPS SE Program has the largest number of students with approximately



**Dr. Ronald E. Giachetti**Chair, Systems Engineering regiache@nps.edu

450 students in resident and distance-learning programs.

It may be no surprise that systems engineering is highly sought after in the US government workforce for those working on weapon system acquisition.

The system engineer is a technically competent professional who can develop system requirements and translates those needs into a system architecture meeting the operational capability needs at the most affordable cost.

The government system engineer is involved in defining operational and technical requirements, tradeoff analysis, system integration, system test and evaluation, and operation and support lifecycle functions. The relevance of systems engineering to defense acquisition is the reason why the NPS program has grown so large so fast.

What may not be so evident is the growth of demand for system engineers in non-defense sectors. A recent salary survey found system engineering jobs have the second highest median salary after petroleum engineers (see <a href="http://www.universityherald.com/articles/53693/20161206/the-top-3-jobs-with-the-highest-and-lowest-salaries.htm">http://www.universityherald.com/articles/53693/20161206/the-top-3-jobs-with-the-highest-and-lowest-salaries.htm</a>). The demand for systems engineering is widespread across industry. In Silicon Valley a search for systems engineering jobs leads to a long list of positions in various industries besides the obvious of software systems. Currently, Silicon Valley firms are gobbling up anyone with education or experience in autonomous systems. Outside of the California technology market, there is growing use of systems engineers in traditional industries. This is seen in the newer systems engineering textbooks such as Bhise's book titled, "Designing complex products with systems engineering processes and techniques." Bhise was an engineer at Ford Motor company and he describes how the automotive industry utilizes systems engineering in car design and development. All of us with a defense systems background can readily recognize the system engineering vee process and all the activities we're used to.

The mission of NPS is to provide a systems engineering education that is highly relevant to defense system acquisition. I believe we perform this mission admirably, but I also see the importance of staying in touch with the larger engineering community. I find it reaffirming to see the value of systems engineering is recognized widely in many different industries.

# Release of Monterey Phoenix (MP) Analyzer 2.0

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Kristin Giammarco Associate Professor kmgiamma@nps.edu Dear Colleagues,

We are pleased to announce the availability of version 2.0 of the MP Analyzer at <a href="http://firebird.nps.edu">http://firebird.nps.edu</a>, which represents a significant milestone in our Monterey Phoenix research for system architecture and process modeling.

In the past year that the MP Analyzer has been in use, we have seen exciting results and applications of MP, including the discovery of unintended behaviors exposed in simulation, use of MP models in automated cost estimation (on SERC Research Task (RT) 137), and experimentation with a mapping of event probabilities to compute entire event trace probabilities (by high school senior (now graduate) Hanna Nilles).

Following are some recent publications from former NPS students of mine (additional publications are in process):

- Hunt, Spencer. "Model-based systems engineering in the execution of search and rescue operations." NPS Master's Thesis, September 2015.
- Steward, Victoria. "<u>Functional flow and event-driven methods for predicting system performance</u>." NPS Master's Thesis, September 2015.
- Pilcher, Joanne. "Generation of Department of Defense Architecture Framework (DODAF) models using the Monterey Phoenix behavior modeling approach." NPS Master's Thesis, September 2015.
- Garcia, Jorge. "Un-building blocks: a model of reverse engineering and applicable heuristics" NPS Doctoral Thesis, December 2015

Release 2.0 significantly extends the MP language features with:

- numeric and Boolean expressions, including first order predicate formulas;
- BUILD blocks for composition operation encapsulation within roots and composite events;
- ENSURE context conditions for event trace generation;
- event trace annotation with SAY and MARK commands:
- conditional composition operation IF-THEN-ELSE;
- assertion checking with CHECK command;
- threads with SUCH THAT conditions.

For details, please see the MP Language Manual linked from the MP wiki's front page at <a href="https://wiki.nps.edu/display/MP">https://wiki.nps.edu/display/MP</a>. We expect these new capabilities to significantly extend the analysis uses of MP.

We hope you will take advantage of this capability for your own applications, and provide us with feedback that will help us to continue improving how we model behavior, and how those models are used. Please share this news with your students or colleagues who conduct research or practice system architecture or process modeling.

Special thanks to CRUSER, the Naval Research Program, Marine Corps Systems Command, and the Systems Engineering Research Center for their sponsorship and support, and, to all of the students who are on the front lines of this research.

Warm regards, Kristin

## RESEARCH

## **West Point Cadet Summer Internship**

Cadet Juan Velasquez, United States Military Academy, spent his summer working with Professor Doug Nelson in the area of measuring and characterizing maritime atmospheric optical turbulence. He aided in the field studies on San Nicolas island in which a laser was shot across the bay in order to collect measurements. The Systems Engineering department regularly hosts interns from the military academies as well as

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civilian schools during the summer months. The research work is part of a larger Navy effort to develop directed energy weapons.

#### Second Series of Rocket Launches for SE Students

The SE3203 class taught by Prof. Yakimenko and Mr. Bobby Wright continued applying core SE approaches gained in other classes to the practical real-world problems. On September 2, 2016 the SE3203 team departed to Mojave Desert to conduct its second series of amature rockets launches. While each student had to build his own rocket in SE3202, this time the students formed three two-member teams to come up with a more sophisticated rocket design. As opposed to the SE3202 rockets the parachute deployment for all SE3203 rockets was triggered by onboard electronics. Its design included redundancy.



One team (McCarthy and Fosu) conceived, designed and built a multiregime rocket capable of flying at subsonic and supersonic speeds (using different motors). The modular design included extended rocket body for a subsonic launch and a shorter version for a supersonic launch. The extra section of the subsonic variant carried a wifi Go Pro camera to record the entire launch event.



LT. Patrick McCarthy, CDR. Christopher Hall, LT. Marcus Torres, Mr. Rushen Dal, and MAJ. Jonathan Swan

Another team (Swan and Christopherson) built a two stage rocket employing two different motors to accelerate the first and the second stages. The third team (Hall and Torres) addressed the USMCWL challenge and developed a rocket capable of carrying a deployable payload – two gliders, to be deployed at the apogee and carry an ISR mission. These gliders were equipped with GoPro cameras as well.

All rocket launches were successful and all parts were retrieved. The rocket launches were recorded by two students from the Temasek Defense Systems Institute at the National University of Singapore (TDSI), Mr. Wong and Mr. Teo, with a stationary and non-stationary cameras. The rocket launch footage will be used to test computer vision algorithms for their theses.

This time the SE3203 team was accompanied by faculty and staff rocketeers as well, to include SE's own Matt Boensel and Rushen Dal, who built a 6" diameter rocket propelled by four motors. The team was also joined by Kristen Tsolis from the Defense Analysis department as well.

Students will describe the project in their reports for the capstone project.

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Matt Boensel and Kristen Tsolis

**Exploring Novel Capabilities Employing Multicopters** 

On the week of December 12th, 2016 SE and MAE students doing their theses under Professor Oleg Yakimenko at the Autonomous Systems Engineering and Integration Laboratory at the SE department participated in the continuing experimentation program at Camp Roberts, CA.

Working on several projects funded by the NPS Consortium for Robotics and Unmanned Systems Education and Research, Naval Research Program, Natick Soldier Research, Development and Engineering Center, and the U.S. Army Picatinny Arsenal, Dr.Yakimenko and his collaborator from the University of Missouri-Kansas City involve students into the leading–edge research and development of future unmanned and autonomous aerial combat platforms.



#### NPS students with their UAVs at Camp Roberts.



DJI Inspre 1 quadcopter on a mission to accompany other quadcopters on their way to provide a collaborative ISR of a "post-disaster area"

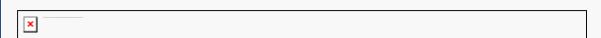


DJI Matrice 600 hexcopter adopted for autonomous aerial payload delivery.

These research projects include using satellite and on board EO/IR sensor imagery for navigation in the GPS-denied environment and aerial threats recognition; vision-based formation flying and collision avoidance; aerial payload delivery using guided parachutes, parafoils and gliders; testing and evaluation of autonomous systems integrity and capabilities.

To conduct these research projects Dr. Yakimenko's group employs a variety of aerial assets. They include a fleet of different-size multicoper platforms. For example, commercial-of-the-shelf DJI Matrice 600 hexcopter was modified and adapted to carry a payload package. Several types of such packages are being designed to fulfill a variety of missions, from large-stand-off-distance covert delivery of sensors and supplies to vertical replenishment in urban operational environment. DJI Matrice 600 quadrotor features an extended flight time (up to 30 min), long range transmission (up to 5 km), powerful app control, capability to lift-off/carry/drop up to 13 lbs payload.

A fleet of smaller quadcopters, including DJI Matrice 100, DJI Inspire 1, Chroma Blade, are being used in the development and field testing of algorithms allowing to rapidly process EO sensor data to provide situational awareness and enable sense-and-avoid capability or, vice versa, provide the guidance commands to intercept an adversary aerial asset. Although all multi-copters are equipped with 4K gimbal cameras, one of the challenges is to build a companion computer and integrate it with an existing autopilot.



#### iPad ground station

On-board video is also streamed down to an operator. At the moment the operator can manually assign the next way-point to fly to or take over the control of a quad completely. Using the same ground station operator can control the camera himself or pass this task on to a sensor operator.

Students recorded tons of video to be processed off-line to further tune object registering and recognition algorithms. Unique video was also recorded by a quadcopter chasing a descending guided parachute. This will allow better understanding aerial payload system dynamics and therefore improving its performance.

Students are continuing working on the development and tuning of algorithms for a fleet of aerial vehicles to be back at Camp Robert in mid-March to retry failed tests and conduct new experiments in support of the needs of Navy and Department of Defense.



Be aware - they are watching us.

## **AY 16 Summer Quarter Graduation**



Provost of Naval Postgraduate School Dr. Steven R. Lerman delivered the commencement address during the Naval Postgraduate School (NPS) Summer Quarter Graduation ceremony in King Auditorium, September 23. (Photo by NPS PAO Office)

## Doctor of Philosophy in Systems Engineering Dr. Joseph P. Cannon

#### Master of Science in Engineering Systems

Mr. Timothy E. Britt Mr. Shane D. Deichman Mr. Robert W. Dodge Mr. Ronnie D. Merrill Mr. Krist D. Norlander LT Philip R. Saulnier, USN

#### Master of Science in Systems Engineering Management

LCDR. Guillerm I. Carrillo, USN LT. Alexander C. Cutting, USN LT John G. Zilai, USN Mr. Troy D. Christensen Ms. Kathi H. Dubar Ms. Margaret S. Duckett Mr. Ronald D. Flight Mr. Ramon A. Garcia\*\* Mr. John J. Geraghty Mr. John F. Gwin Mr. John C. Hill Mr. John D. Lillard Mr. John K. Logan Jr. Mr. John A. Peters Mr. Matthe B. Rambo Mr. Michael B. Revill\*' Mr. Javier A. Rinaldi Mr. Jason A. Schwartz Mr. Birse T. Jr

# Master of Science in Systems Engineering MAJ. Eng Soon Lim, Singapore Army\*\*

CPT. Kenny Shen Yong Too, Singapore Army CPT. Kevin Weihao Soon, Singapore Army LTC. Melvin Cheang, Singapore Navy LTC. Mong Lin Sin, Singapore Navy\* Mr. Luhai Wong Ms. Siew Peng Yue LT Jeffrey P. Sharp, USN Mr. Evan Applegate Mr. Brian C. Arena Mr. Justin R. Berrier Mr. Benjamin D. Breitberg Mr. Nicholas H. Casey Mrs. Shauntrelle D. Caston Mr. David J. Doughty II Ms. Alyssa B. Day Ms. Janelle C. Droubay Mr. David J. Faust Mr. John C. Henderson Mr. Benjamin S. Hobson Ms. Daphne L. Holcomb Ms. Caroline Lazar Mr. David J. Lee Mr. Brian L. Maples Mr. Theron M. McCray Mr. Raymond C. Myers III Mr. Juan C. Pesante Ms. Katherin V. Phillips Mr. Luis A. Rivera Vega Mr. Patrick H. Stack Mr. John A. Stern Mr. Yooku Tachie-Menson Mr. Kevin M. Teig

Mr. Casey S. Whitman Mrs. Kristie Jo Wilkerson Mr. Aterrell B. Willis

- \* Distinction
- \*\* Outsanding Thesis



## **Summer Graduation Awards**

## **Meyer Award Winners**

The Meyer Award for Outstanding Student in Systems Engineering (Distance Learning) is presented to an outstanding Department of Defense graduate of each Distance Learning Systems Engineering degree program who has demonstrated superior academic performance. This quarter, the award was presented to Ms. Kathi H. Dubar, Mr. Justin R. Berrier, and Ms. Krstie Jo Wilkerson.



Ms. Kathi H. Dubar, 721-141

# Dr. Joseph Cannon Graduates with PhD in Systems Engineering

Joseph Cannon graduated from NPS with a PhD in Systems Engineering in September 2016. The title of his dissertation is: "Toward a Methodology for the System Integration of Adaptive Resilience in Armor." This dissertation introduces a novel augmentation to systems engineering methodology based on the integration of adaptive capacity, which produces enhanced resilience in technological systems that operate in complex operating environments. The implementation of this methodology enhances system resistance to top-level function failure or accelerates the system's functional recovery in the event of a toplevel function failure due to functional requirement shift, evolutions, or perturbations. Specifically, the dissertation defines and proposes a methodology to integrate adaptive resilience and demonstrates its implementation in a relevant armor system case study.

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Dr. Giachetti, Dr. Cannon, and Dr. Paulo

The conceptual validity of the methodology is proven through a physical comparative test and evaluation of the system described in the case study. The research and resulting methodology supplements and enhances traditional systems engineering processes by offering systems designers the opportunity to integrate adaptive capacity into systems, enhancing their resilient resistance, or recovery to top-level function failure in complex operating environments. The research expands traditional and contemporary system engineering, design, and integration methodologies, which currently do not explicitly address system adaptation and resilience. The methodology accomplishes this objective by defining adaptive design considerations, identifying controllable adaptive performance factors, characterizing adaptive performance factors and configurations, mapping and integrating adaptive components, and verifying and validating the adaptive components and configurations that achieve system requirements and adaptive design considerations. The utility of this research and methodology is demonstrated through development of an adaptive resilient armor system called the mechanically adaptive armor linkage (MAAL), which was designed, developed, and validated using the methodology for the system integration of adaptive resilience (MSIAR).

Dr. Joseph Cannon currently serves as the US Army Tank Automotive Research Development Engineering Center (TARDEC), Lead for Global Engagements. In this role Dr. Cannon serves as TARDECs chief ambassador and facilitator for global defense engagements. Dr. Cannon previously served as a Senior Mechanical Engineer with TARDEC's Ground System Survivability Directorate. In this role Dr. Cannon developed novel combat and tactical vehicle armor technologies, earning the 2008 Army's Greatest Invention for MRAP EFP Armor and 6 patents for novel armor technology designs.

MAJ Joseph Cannon (US Army Reserves) also serves as the Chief of Staff/Executive Officer for the 1-125 Infantry Regiment, 37th Infantry Brigade Combat Team. In this role, MAJ Cannon is responsible for the planning, resourcing and execution of all training and operations for an 811 man Light Infantry Battalion. MAJ Cannon has served two combat tours in support of Operation Enduring Freedom. Joseph Cannon has been awarded the Bronze Star Medal, Army Commendation Medal with three Bronze Oak Leaf Clusters, Army Achievement Medal with a Bronze Oak Leaf Cluster, Army Valorous Unit Award, Ranger Tab, Combat Infantry Badge, Expert Infantry Badge and Basic Parachutist wings.

Dr. Joseph Cannon graduated from Michigan Technological University with honors, earning a Bachelors of Science in Mechanical Engineering. Dr. Cannon also holds a Master of Science and a Doctorate of Philosophy in Systems Engineering from the Naval Postgraduate School.



# NPS Department of Systems Engineering Graduates First Missile Defense Agency Cohort



NPS' Department of Systems Engineering (SE) graduated its first cohort from the Missile Defense Agency (MDA), pictured above, during NPS' 2016 Summer Quarter Graduation Ceremony, Sept. 23. The cohort, comprised of distance learning students from several different fields, worked together on a capstone project titled, "MDA Ballistic Missile Defense System-of-Systems Modeling and Simulation Needs and Gaps."

"The professors were very knowledgeable and helpful. We were able to relate to them because they worked in the same field," said NPS Student Theron McCray whose work centers on Aegis operational capacity. "They understood the challenges we have at the MDA."

Attending the commencement ceremony was MDA Deputy Director for Engineering Dennis Mayes and Director for Engineering and Career Development Dr. Pamela Knight. They worked closely with the SE department to develop the curriculum.

"NPS is one of the best systems engineering programs around," said Knight. "[Associate Chairman for Distributed Programs and Outreach Dr. Walter] Owen was great. He was flexible, doing what we needed because we are a very high op-tempo organization."

Mayes agreed. He is currently focused on matching his graduates with positions suited to their newfound capabilities.

"What I plan to do is look at what their curriculum was and where our critical needs are. We are always looking to train great engineers ... and with what they have learned, put them in critical locations so they can lead the way," said Mayes.

NPS Department of Systems Engineering Professor and Chair Dr. Ronald Giachetti is proud of the work that his faculty and students are accomplishing.

"We are very proud of our program. We feel that we are leaders in delivering distance learning education at the graduate level," said Giachetti who also noted that his program has one of only two accredited graduate systems engineering degrees.

By MC2 Michael Ehrlich

## **AY 17 Fall Quarter Graduation**

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Under Secretary of the Navy the Honorable Janine Davidson offers the commencement address during the Naval Postgraduate School's (NPS) Fall Quarter Commencement Ceremony at King Auditorium, Dec. 16. The university said farewell to 326 graduates, including 39 international students from 16 nations, earning 328 advanced degrees during the ceremony. Photo by NPS PAO Office.

Master of Science in Systems Engineering Analysis LT. Alexander M. Kelly, USN

#### Master of Science in Systems Engineering

LT. Jude C. Ezedike, USN LT. Adam C. Haag, USN LT. Chaz R. Henderson, USN LT Christopher J. Horel, USN LT. Bradley A. Johnson, USN LT. Antonios Lionis, Hellenic Navy \* LT. David R. LaShomb, USN LCDR Tyler B. McDonald, USN LT. William L. Davidson, USN LT Shawn A. Hoch, USN LCDR Jason D. Weaver, USN Mr. Trevor Brown Mr. Jonathan R. Chan Mr. Joseph Yen Chen. Mr. Reniery Cevallos Mr. Joshua D. Culp Mr. Joshua T. Davis Mr. Richard R. Domondon

Mr. Jon K. Feeney

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#### Dr. Davidson and LT. Ezedike

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Dr. Davidson and Mr. Richard Domondon

Mrs. Amy E. Hays
Mr. Jeremy Hoff
Mr. John Joseph Kady
Ms. Jennifer E. Kays
Mr. Aadm E. Martin
Mr. Jose M. Martinez-Casiano
Mr. Cleevens Meus
Mr. Keith J. McCrorey
Mr. Earl C. Moore
Mr. William M. Robinson
Mr. Lucas W. Romas
Mr. Mrinal Saha
Mr. Jesse W. Sumner
Mr. Raymond T. Tagulao

#### Master of Science in Engineering Systems

LT. James P. Morrison, USN Mr. Chadwick M. Cummings Ms. Konawetish R. Fields Mr. Thomas E. Scheurich, Jr

- \* Distinction
- \*\* Outsanding Thesis

## **Fall Graduation Awards**

## **Meyer Award Winners**

The Meyer Award for Outstanding Student in Systems Engineering (Distance Learning) is presented to an outstanding Department of Defense graduate of each Distance Learning Systems Engineering degree program who has demonstrated superior academic performance. This quarter, the award was presented to Mr. Jeremy Hoff and Ms. Jennifer Kays.



Dr. Davidson and Ms. Jennifer Kays

## **FACULTY**

### **NEW FACULTY MEMBER**



## Dr. Bryan O'Halloran

Dr. Bryan O'Halloran is currently an Assistant Professor in the Systems Engineering (SE) department at the Naval Postgraduate School (NPS). Prior to joining NPS, he was a Senior Reliability and Systems Safety Engineer at Raytheon Missile Systems and the Lead Reliability and Safety Engineer for hypersonic missile programs. He holds a Bachelor of Science degree in Engineering Physics and a Master of Science and Doctorate of Philosophy in Mechanical Engineering from Oregon State University. His current research interests include risk, reliability, safety, and failure modeling in the early design of Complex, Cyber-Physical Systems (CCPSs). He is a member of the American Society of Mechanical Engineers (ASME) and the Institute of Electrical and Electronics Engineers (IEEE) and regularly attends the International Design Engineering Technical Conference (IDETC), the International Mechanical Engineering Congress and Exposition (IMECE), and the Reliability and Maintainability Symposium (RAMS).

# **Upcoming Conferences & Call for Papers**

2017 NDIA Human Systems Conference, Springfield, VA March 7 - March 8, 2017

Conference on Systems Engineering Research (CSER) 2017– Los Angeles, CA March 23-25, 2017 http://viterbi.usc.edu/sae/cser2017.htm

Conference on Systems Engineering Research (CSER), Los Angeles, CA, March 23-25, 2017. (Deadline for papers is Oct 2 2016).

IEEE 11th Systems Conference, Montreal, Canada, April 24-27, 2017 (deadline for manuscript Oct 14 2016)

IISE Conference 2017 - Pittsburg, PA, May 20-23, 2017 http://www.iienet2.org/Annual2/default.aspx

20th IFAC World Congress 2017 - July 9 - 14, Toulouse, France http://www.ifac2017.org

INCOSE IS 2017 - Adelaide, Australia, Date: Jul 17, 2017 - Jul 20, 2017

2017 IEEE International Conference on Systems, Man and Cybernetics (SMC) Banff, Canada, Oct 1 – Oct 4, 2017 (Abstract submission deadline: 01 Apr 2017

## **FACULTY AWARDS**



#### Mark Rhoades

SE Lecturer, Mark Rhoades was presented the Meyer Award for Teaching Excellence in Systems Engineering (Distance Learning) for the AY16 Summer Quarter. The award is presented to an outstanding faculty member of each Distance Learning Systems Engineering degree program who is recognized by the students for teaching excellence

	and/or exceptional contributions to the student's overall learning experience.
- X	Don Muehlbach  SE Lecturer, Don Muehlbach was presented the Meyer Award for Teaching Excellence in Systems Engineering (Distance Learning) for the AY17 Fall Quarter. The award is presented to an outstanding faculty member of each Distance Learning Systems Engineering degree program who is recognized by the students for teaching excellence and/or exceptional contributions to the student's overall learning experience.
×	Chris Wolfgeher  SE Research Associate, Chris Wolfgeher earned his CSEP (Certified Systems Engineering Professional) credential from the International Council on Systems Engineering (INCOSE). The CSEP credentials are a formal recognition of the Systems Engineering capabilities, knowledge, and experience of the recipient.
×	Greg Miller  SE Lecturer, Greg Miller was presented the Meyer Award for Teaching Excellence in Systems Engineering (Distance Learning) for the AY17 Fall Quarter. The award is presented to an outstanding faculty member of each Distance Learning Systems Engineering degree program who is recognized by the students for teaching excellence and/or exceptional contributions to the student's overall learning experience.
Request for	Alumni News!

The SE Department is interesting in hearing how our alumni are doing. Please feel free to send us news items for inclusion in future newsletters.

# **Announcements**

#### Please visit our NPS SE Website!

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