Graduate Education for Unmanned Vehicles and Undersea Warfare

NPS Teaching, Research and Partnership Strategies

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Topics

• NPS
• Undersea Warfare curricula
• Unmanned Systems research
• Partnerships with industry
• Exemplar projects
Naval Postgraduate School (NPS)

- U.S. Navy’s University
  - Mission: graduate education + relevant research
- Numerous curricula, most sciences & engineering
  - 2-year masters degrees with thesis
  - Ph.D. research
- Joint, allied and civil-service students, faculty
  - USN, USMC, USA, USAF: ~1300
  - International student officers: ~350
  - Faculty ~300
- Research efforts significant
  - FY2004 reimbursables: $100M
• Multiple masters degrees (not a USW degree)
  ▪ Physical Oceanography
  ▪ Electrical Engineering – Signal Processing
  ▪ Physics – Engineering Acoustics
  ▪ Operations Research – TDAs, search etc.
  ▪ Proposed: MSES Unmanned Systems

• Each major typically a 2-year program
  ▪ 29 students on board, plus 7 graduating tomorrow
  ▪ 2 dozen interdisciplinary faculty
  ▪ Special 1-year Immediate Grad. Ed. Program (IGEP)
  ▪ Must have: masters thesis of directed independent work
Critical curriculum components

- Accredited hard-science degrees
- Apply learning to real research challenges
  - Masters thesis, doctoral dissertation
- Cross-disciplinary exposure
  - Academic disciplines
  - Tactical communities for “team-sport” USW: aviation, surface, subsurface, environmental
- Apply naval-officer student expertise
NPS ASW Certificate

- Four courses offered via distance learning
  - Correspond to initial courses in USW curriculum
  - Offered quarterly, cross-disciplinary subjects
  - Some prerequisites necessary
- Various mechanisms for distance-learning delivery: Web, video teleconferencing, etc.

- Naval officers and civil servants eligible
- Looking for students and sponsorships
Partnerships with industry

• Joint work, use of equipment, software
• Cooperative Research and Development Agreements (CRADA)
• Key players at NPS:
  ▪ USW Chair VADM Roger Bacon USN Ret.
  ▪ MIW Chair RADM Rick Williams USN Ret.
• Unparalleled cross-disciplinary faculty
  ▪ Cover full range of scientific and engineering disciplines
  ▪ Leaders: please send us your list of too-hard problems
• Industry and government welcome to use our work
  ▪ Visiting engineers and scientists also welcome
We operate vehicles every week

- Center for Autonomous Underwater Vehicle (AUV) Research
  - Tony Healey, Principal Investigator
  - 3rd-generation ARIES vehicle, also one REMUS
  - Over 120 M.S., Ph.D. graduates since 1987

- UAV center also established
  - Multiple airframes, nearby airport
  - 23 Km range to surfaced AUV with 802.11G

- USV center being proposed
  - Have applied for SeaFox USV, others welcome
Associated exemplar NPS efforts
SeaWeb Acoustic LAN

- Communications at speed and depth
- Synthesis of acoustics and networking
- Bandwidths are not becoming huge, but steady connectivity is possible
- Ongoing series of demonstrations including Pacific Fleet TASWEX fall 2005
usw-xml Working Group

• The usw-xml working group is improving Undersea Warfare (USW) interoperability using Extensible Markup Language (XML) tagsets for system data interchange.

• Cooperative collaboration between many stakeholders is needed for interoperability.
  ▪ No one community can solve this in isolation

• Sponsored by NAVSEA PEO IWS
  ▪ Perhaps first tactical DoD Community of Interest

• NPS and NUWC Newport lead this effort
Modeling, Virtual Environments and Simulation (MOVES)

• Our mission is research, application and education in the grand challenges of modeling, virtual environments, and simulation.

Research Directions

• The research product directions include
• 3D visual simulation and networked virtual environments
• Computer-generated autonomy, computational cognition
• Human-performance engineering, immersive technologies
• Game-based simulation, understanding, and analysis
• Combat modeling and analysis
AUV Workbench

- Underwater, air, surface unmanned vehicles
- Build scientific TDA with full-fidelity physics
  - Rehearsal: mission planning
  - Reality: real-time tasking and monitoring
  - Replay: playback telemetry
- Multiple sponsors & partners: NAVO/NRL, NUWC Newport, NAVAIR, Sonalysts, et al.
- Open source, open standards, new tech
  - Extensible 3D Graphics (X3D) for large worlds
  - XML, binary compression for GIG Web Services
Summary themes

• NPS is the Navy’s corporate university
• Solid graduate education is essential for naval officers and civilian engineers

• USW (ASW + MIW) robotics are hard
• Cross-disciplinary interoperability is the key to solving next-step challenges

• Test & evaluation are essential throughout
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