



Naval Surface Warfare Center

PORT HUENEME DIVISION

- November 8, 2018 -

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Office of Research and Technology

STATEMENT A - Approved for Public Release; Distribution is unlimited.





NAVSEA Warfare Centers: 10 Divisions – 1 Team

Naval Surface Warfare Center

NSWC Crane Division
Crane, Ind.

NSWC Carderock Division
West Bethesda, Md.

NSWC Panama City Division
Panama City, Fla.

NSWC Dahlgren Division
Dahlgren, Va.

NSWC Corona Division
Corona, Calif.

NSWC Philadelphia Division
Philadelphia, Penn.

NSWC
Port Hueneme Division
Port Hueneme, Calif.

NSWC Indian Head Explosive
Ordnance Disposal
Technology Division
Indian Head, Md.

NUWC Keyport Division
Keyport, Wash.

NUWC Newport Division
Newport, R.I.

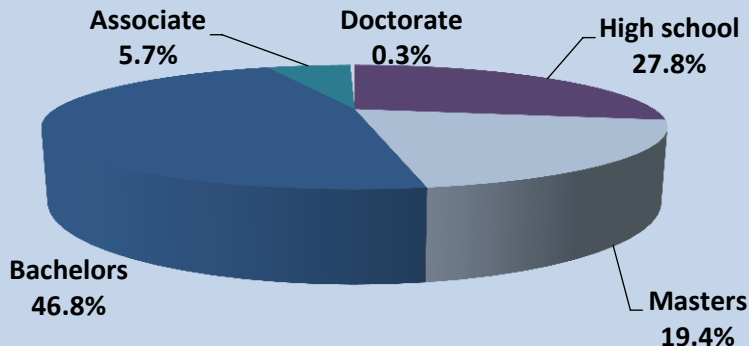
Naval Undersea Warfare Center





Port Hueneme Division

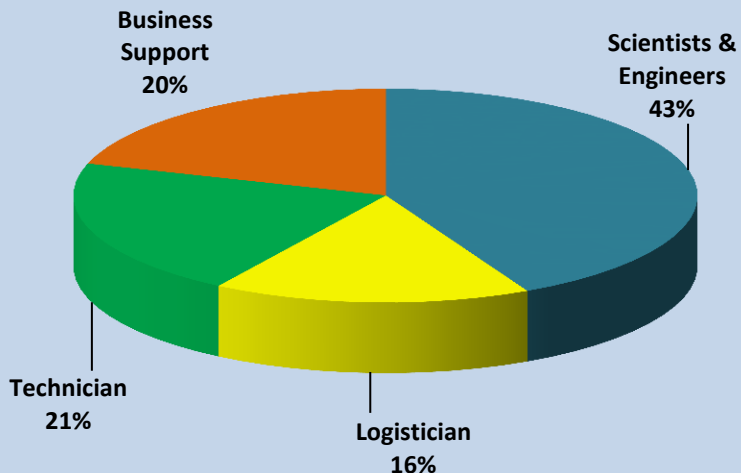
Civilian Education Level



**MILITARY MEMBERS -
23 OFFICERS, 68 ENLISTED**

- **Bring Fleet Perspective and Experience**
- **Gain Technical Leadership Expertise**

Business Support 20%



CIVILIANS - 2,346

- **Long-Term Technical Accountability**
- **Essential Core Skills and Expertise**

INDUSTRY - 1,593

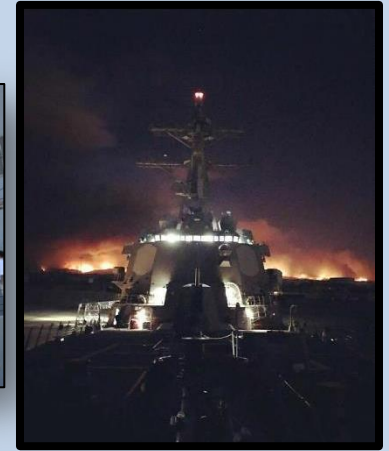
- **Complement Government Knowledge Base**
- **Critical Industrial and Product Development Services**





What We Do

Operational Fleet Support



Test and Evaluation



Research and Development





Unique Assets

**Self Defense
Test Ship**



**Surface Warfare
Engineering Facility**



**Underway
Replenishment**



**Mission Package
Support Facility**





The Future

Research, development and application of advanced technology enabling the ISEA of the future to optimize the lifecycle sustainment and iterative improvement of the ship, combat and weapons systems deployed to the Fleet.



- Predictive Analysis
- Augmented Reality
- Automation
- Data Analytics
- Deep Learning
- Artificial Intelligence
- Machine Learning
- Neural Networks
- Autonomy
- Unmanned Systems
- Data-Driven Decision Support



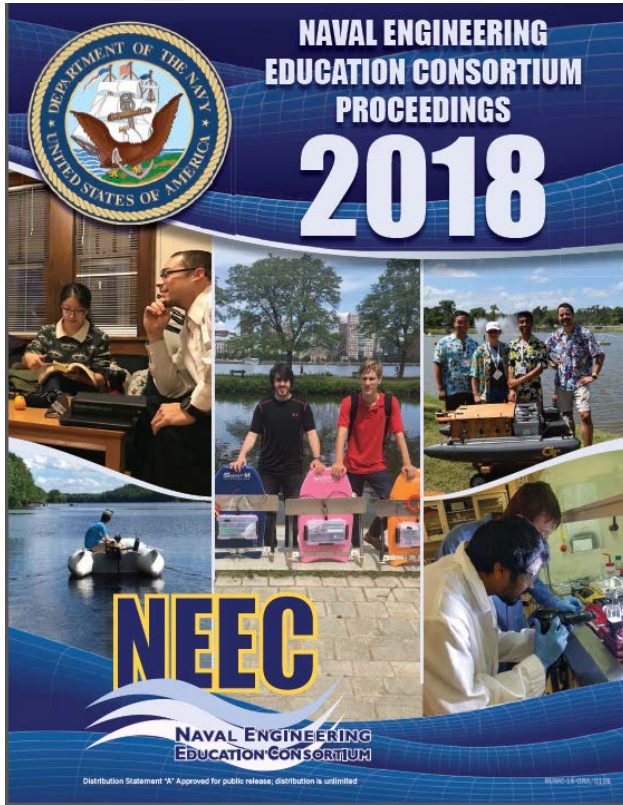
Strategic Partnerships

- Work With Private Parties
- Partnership Intermediary Agreements
- Cooperative Research and Development Agreements (CRADA)
- Educational Partnership Agreements

Strategic partnerships to extend the Command's research and development capabilities



Naval Engineering Education Consortium



The Naval Engineering Education Consortium was established to develop and attract new professionals into the broad technical fields associated with current and future U.S. Navy ships and submarines.

- Project-based research activities are aligned with future technical capabilities at each Warfare Center
- Emphasis is placed on hiring students that participated in the NEEC Program

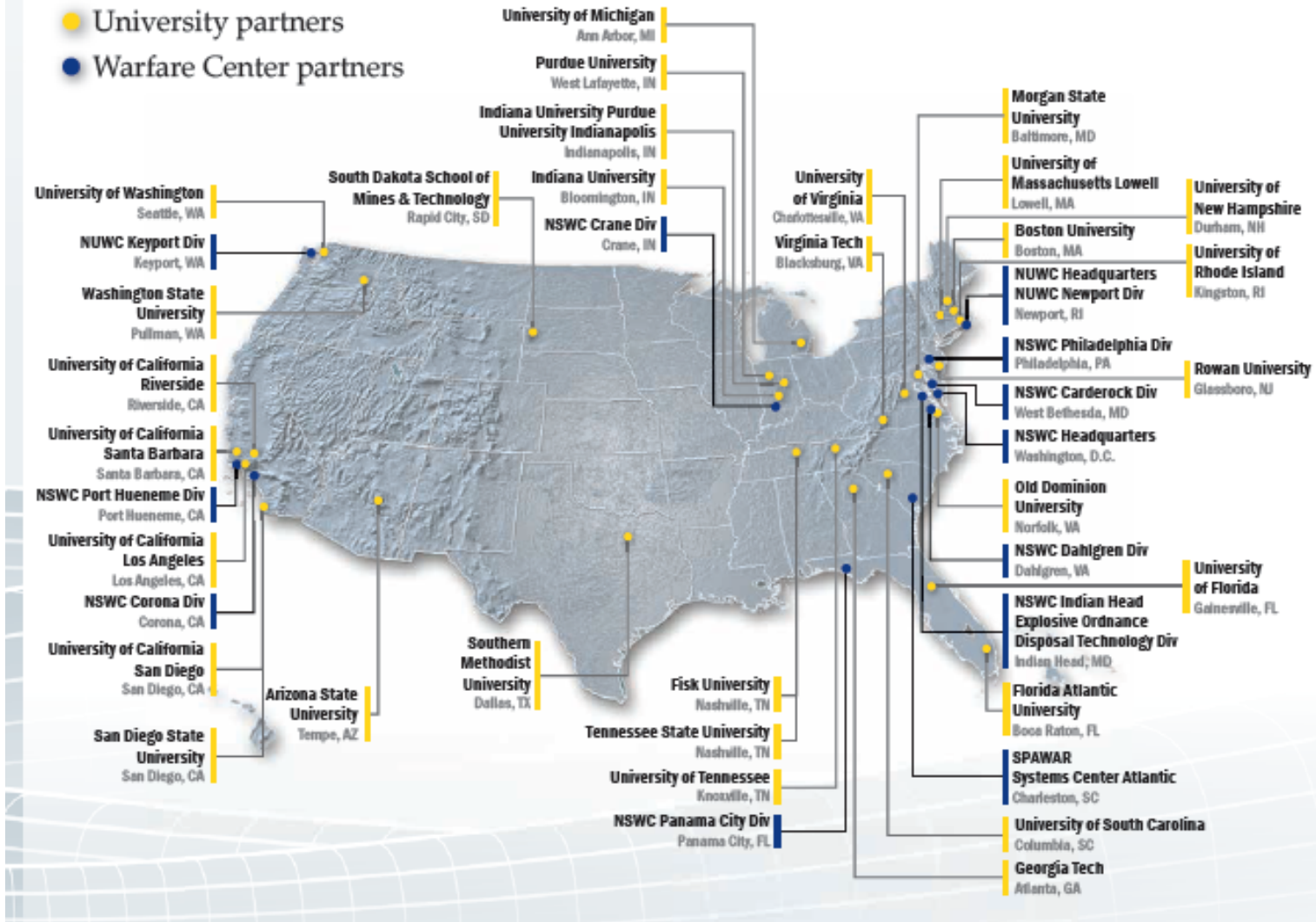
FY2018 Highlights:

- ✓ NSWC Port Hueneme funded \$450k in Grant research activities to 2 Universities
- ✓ 3 Research Projects Funded
- ✓ 6 Students hired Full-Time by NSWC PHD
- ✓ 3 Peer Review Journal Artifacts published and Presented
- ✓ Expanding and re-aligning program with ISEA of the Future Campaign

NEEC Consortium

The Consortium

- University partners
- Warfare Center partners



NEEC Research at USCB

NSWC Port Hueneme

Atmospheric Turbulence Generation in Multiphase Flows with Density Stratification and Phase Change

Professor: Eckart Meiburg

Technical Capability Alignment: PH09 Directed Energy and Electric Weapon Systems ISE, T&E, and IPS

Students:

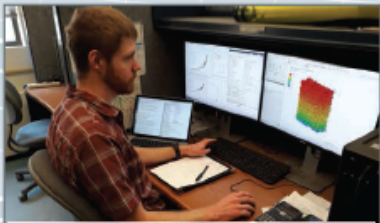
- Masters: 1
- PhD: 2

University of California, Santa Barbara



In the first part of the project, we investigate the influence of shear on double-diffusive and settling-driven instabilities, by means of a transient growth analysis. Employing Kelvin waves within a linearized framework allows for the consideration of time-dependent waveforms in uniform shear. In this way, the effects of boundaries and of shear-driven instability modes can be eliminated, so that the influence of shear on the double-diffusive and settling-driven instabilities can be analyzed in isolation. Shear is seen to dampen both instabilities, which is consistent with previous findings by other authors. The shear damping is more pronounced for parameter values that produce larger unshored growth. These trends can be explained in terms of instantaneous linear stability results for the unshored case. For both double-diffusive and settling-driven instabilities, low Pr-values result in less damping and an increased importance of the Orr mechanism, for which a quantitative scaling law is obtained.

In the second part of the project, we conduct fully-resolved simulations of dense particle-laden flows under laminar conditions in order to better understand the rheology of such flows. Carrying out a detailed momentum balance for the fluid and particle phases, we find that the stresses remain in equilibrium even during unsteady flow conditions. We also investigate the rheology of the particle-laden flows under two frameworks: effective viscosity and the macroscopic friction coefficient, or $\mu(I)$ rheology. While the results collapse better under the effective viscosity framework, none of the models considered can fully describe the rheology of the observed results. The tangential lubrication force acting between particles also plays a large role in the results and should be investigated further.



Student performing three-dimensional, grain-resolving simulations of two-phase flows. Such high-resolution simulations help us understand and quantify the rheology of particle-laden flows.



Student employing computational fluid dynamics (CFD) tools to analyze the effect of shear on double-diffusive and settling-driven instabilities in the ocean.



Students diagnose a MANDRAKE infrastructure problem.



University of California, Santa Barbara



The goal of MANDRAKE is to leverage the recent breakthroughs in commercial analytics and cloud computing to predict functionality and performance failures from critical software and hardware infrastructure systems. To accomplish this goal, MANDRAKE must meet three key objectives. It must:

1. develop prediction methodologies that are specifically designed to predict hardware and software systems failure in an automated "lights out" manner,
2. be able to support the plethora of new analytics technologies that are available (largely as free open source) that can be brought to bear on the problem of failure prediction, and
3. itself be robust and failure resilient to a greater extent than the systems it monitors.

Our recent work has focused on the research that is needed to meet these objectives. Specifically, the team has been working on the "lights out" deployment problems that will allow the MANDRAKE platform to work as an appliance. In addition, the team has been studying the robustness characteristics of the initial platform prototype. The recent fires in the Santa Barbara area provided an excellent real-world opportunity to investigate the effect of intermittent power availability on the stability of the platform.

The team also studies new adaptive algorithms for deadline-driven cloud execution of machine learning codes. In particular, one student developed a model for executing the stochastic gradient algorithm (used at the heart of many machine learning applications) that allows a user to predict the level of convergence the application will achieve by a specific future deadline.

Students diagnose a MANDRAKE infrastructure problem induced by power fluctuations experienced by UCSB during the recent Thomas Fire incident.

NSWC Port Hueneme

MANDRAKE: a Maintenance AND Remediation Anticipatory Knowledge Environment

Professor: Rich Wolski

Technical Capability Alignment: PH02 Surface and Expeditionary Combat Systems ISE, T&E, and IPS

Students:

- Undergraduate: 1
- Masters: 2



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