

Welcome Message

Welcome to the 2023 Electric Ship Technology Symposium (ESTS). On behalf of the ESTS organizing committee, we would like to thank each of you for attending this meeting to exchange ideas on the future of electric ship technologies.

The Electric Ship Technology Symposium began in 2005, largely as a result of U.S. Navy interest in electric ships. We particularly thank the U.S. Navy, specifically the U.S. Office of Naval Research, for their support of this technical area. Recent years have seen huge advances in electrification of the broader maritime sector in response to environmental, political, and economic pressures, with corresponding development of electric ship technologies. The goal of this conference is to welcome everyone interested in electric ships to both learn and contribute new technical knowledge to this growing area. Our speakers, presenters, and patrons from the recreational, commercial and military sectors represent a broad array of ship electrification applications.

As we collectively participate in this year's symposium we appreciate the generous support provided by our sponsors. Please be sure to visit the exhibition booths during the conference.

We also thank the IEEE Power and Energy Society and the IEEE Power Electronics Society for technical and financial sponsorship of this conference, and the IEEE Transportation Electrification Community for technical sponsorship. Their technical and financial sponsorship make the conference possible.

We would also like to draw your attention to the call for papers for the IEEE Transactions on Transportation Electrification (TTE) Special Issue on Electrified Ship Technologies, which has a submission deadline of January 31, 2024. The topic areas of the special issue are aligned with those of this conference and provide an excellent venue for further expansion of topics discussed here.

We hope that each of you will find the conference to be enjoyable, stimulating, and enlightening.

Dr. Julie Chalfant
MIT Sea Grant College Program, Massachusetts Institute of Technology
Chair, ESTS 2023

Dr. Michael "Mischa" Steurer
Center for Advanced Power Systems, Florida State University
Co-chair, ESTS 2023

Organizing Committee

General Chair

Julie Chalfant – *Massachusetts Institute of Technology*

General Co-Chair

Michael “Mischa” Steurer – *Florida State University*

Technical Program Chair

Andrew Lemmon – *University of Alabama*

Technical Program Co-Chair

Raghav Khanna – *University of Toledo*

Treasurer

Aaron Cramer – *The University of Kentucky*

Wayne Weaver – *Michigan Technological University*

Publicity Chair

Harshita Singh – *Purdue University*

Publication Chair

Tuyen Vu – *Clarkson University*

Tutorial Chair

Dan Opila – *United States Naval Academy*

Sponsorship

Mischa Steurer – *Florida State University*

Roger McGinnis – *Florida State University*

IEEE Conference Manager

John Teehan – *IEEE*

PELS Liaison

Omer Onar – *Oak Ridge National Laboratory*

MSCC Liaison

Fabio D’Agostino – *University of Genova*

Administrative Support

Aoife Trotter

Technical Committee

Technical Program Chair

Andrew Lemmon, *University of Alabama*

Technical Program Co-Chair

Raghav Khanna, *University of Toledo*

Members

Terry Ericson, *Ericson Innovations, LLC*

Mohamad Zahzah, *Ultra EMS*

Harish Suryanarayana, *ABB*

Ali Davoudi, *University of Texas Arlington*

Dwight Alexander, *Northrup Grumman*

Giorgio Sulligoi, *University of Trieste*

Patrick Lewis, *General Electric*

Ben Ford, *Hepburn & Sons*

Stephen Kuznetsov, *Raytheon*

Michael Mazzola, *University of North Carolina Charlotte*

Mona Ghassemi, *Virginia Tech University*

Marie Lawson, *Ingalls Industries – Newport News Shipbuilding*

Ali Bazzi, *University of Connecticut*

Fletcher Fleming, *DRS Technologies*

David Wetz, *University of Texas at Arlington*

Aaron Brovont, *PC Krause & Associates*

Rob Cuzner, *University of Wisconsin Milwaukee*

Raghav Khanna, *University of Toledo*

Jim Turso, *Ingalls Industries – Newport News Shipbuilding*

Salem Elsaiah, *State University of New York*

Brandon Grainger, *University of Pittsburgh*

Michael Hontz, *NSWC-Philadelphia*

Robert Irwin, *NSWC-Philadelphia*

Christina DiMarino, *Virginia Tech University*

Timothy McCoy, *University of Michigan*

Mischa Steurer, *Florida State University*

Cheng Siong Chin, *New Castle University*

Josep Guerrero, *AAU Energy*

Hua Zhang, *Drexel University*

Jason Lai, *Virginia Tech University*

Fabio D'Agostino, *University of Genova*

Constanza Ahumada, *Universidad de Chile*

Jian Shi, *University of Houston*

Patrons

The Electric Ship Technology Symposium gratefully acknowledges our patrons for the financial support and the United States Office of Naval Research for sponsoring much of the research presented herein.



Platinum Patron



Ferraz Shawmut | Eldre | Idealec | FTCAP

Gold Patrons



Silver Patrons



Technical Sponsors



Financial Sponsors



WHEN RELIABILITY
IS THE PRIME
OBJECTIVE...



Mersen's Rochester, NY plant is registered under the ITAR with the U.S. State Department's Directorate of Defense Trade Controls (DDTC). Mersen's Rochester, NY plant is AS 9100 certified.

MERSEN PRODUCTS DELIVER

Thanks to its undisputed reputation in bus bar, cooling, fusing, capacitor design and manufacturing, Mersen is your preferred partner to assist you during the development phase of your project. Mersen brings technical cross-expertise on these 4 key products to push the optimization to the limit.

EP.MERSEN.COM

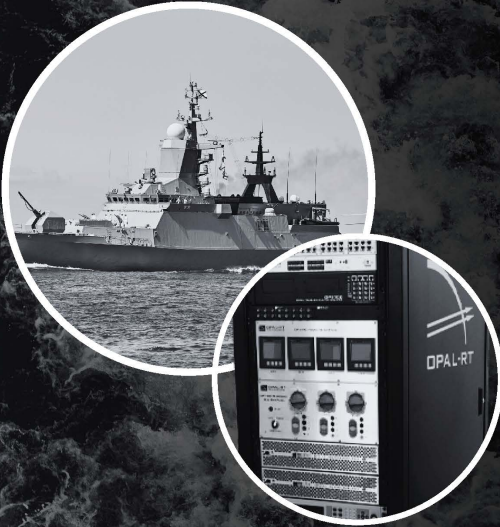
MERSEN
Expertise, our source of energy



OPAL-RT
TECHNOLOGIES

POWERING INNOVATION AT SEA

Ensure the reliability and
the survivability of the
shipboard power system
and enhance the mission
effectiveness of modern
electric ship



Learn more about
our solutions
www.opal-rt.com



Raising the World's Standards

IEEE Standards Association (IEEE SA) convenes diverse communities of innovators from around the world to facilitate market-relevant global standards development and standards related collaboration.

Whatever your industry, technology or interest, IEEE SA provides a meaningful place to network, grow and shape future technologies.

Join Us!
standards.ieee.org



Leaders in electric ships
have something in common.

They use real-time simulation to test their systems.

How do you pre-commission novel control systems?

The RTDS® Simulator is the world standard for real-time digital simulation, used globally for the closed-loop testing of protection and control systems. Real-time simulation is bringing the smart grid, distribution automation, and grid-edge connectivity to life in real time.

Testing new devices and schemes with a simulated grid throughout development and prior to installation is efficient, safe, and reliable.



Your world in real time.

Learn more at rtds.com



GENERAL DYNAMICS
Mission Systems



**INTEGRATING AND
SUSTAINING ANY PROGRAM
WITH ANY MISSION SYSTEM
ON ANY PLATFORM**

GDMISSIONSYSTEMS.COM/SEA

© 2023 General Dynamics Mission Systems. All rights reserved.

Keynote Speaker

Wednesday, August 2

J. Carey Filling

Director for Surface Ship Design and Systems Engineering,
Naval Sea Systems Command

J. Carey Filling serves as the Director for Surface Ship Design and Systems Engineering (SEA 05D), head of the Group within the Naval Sea System Command's Naval Systems Engineering Directorate that provides the technical leadership to ensure current and future U.S. Navy surface ships can safely and effectively perform mission requirements.



Mr. Filling was promoted to the Senior Executive Service in February 2019. He has a total of 10 years of Civilian Service in the Federal Government. After serving as a NAVSEA contractor for 16 years, his federal career began in 2009 where he managed the ship concept development for the DDG 51 Destroyer Flight Upgrade Study as the Senior Ship Concept Manager (SSCM), seeking to provide Integrated Air and Missile Defense (IAMD) improvements to this formidable platform.

In 2010, Mr. Filling served as the warranted Senior Ship Design Manager, DDG 51 Flight III Destroyer / Future Surface Combatant for NAVSEA 05D2. He executed the systems engineering effort to develop technically feasible ship concept designs which integrated the Air and Missile Defense Radar into the DDG 51 FLT IIA Platform including upgrades to power and cooling architectures.

In 2012 he was selected as the Director for the U.S. Navy's Naval Sea Systems Command (NAVSEA) 05D2 – Surface Combatant & Mine Warfare Ships Design and Engineering Directorate, responsible for design and engineering management of the DDG 51 FLT IIA and III Destroyers, DDG 1000 Destroyer, Littoral Combatant Ship Freedom and Independence Variants, LCS Mission Modules, FFG(X) Future Frigate, Saudi Multi-Mission Surface Combatant (FMS), and ship-launched Unmanned Maritime Systems (UMS).

Mr. Filling holds a Bachelor of Science degree in Naval Architecture & Marine Engineering from the Webb Institute of Naval Architecture, and both a Masters of Business Administration (MBA) and a Master of Science in Supply Chain Management & Information Technology from the Robert H. Smith School of Business at the University of Maryland. He is a DAWIA Systems Planning, Research, Development and Engineering Level III certified professional. He is the 2010 recipient of the American Society of Naval Engineers (ASNE) Frank G. Law Award for outstanding contribution to the advancement of the society.

Keynote Speaker

Thursday, August 3

Jin Wang

Director of Technology within the Corporate Technology Department at the American Bureau of Shipping (ABS)

Ms. Jin Wang is the Director of Technology within the Corporate Technology Department at the American Bureau of Shipping (ABS) in Houston, Texas. Wang is a member of the Working Group of IEEE P45.1 Recommended Practice for Electrical Installations on Shipboard Design.



Throughout her professional career, she has continued to expand her knowledge in the marine and offshore industries, especially in the areas of maritime electrification, shore power, zero-emission vessels, hybrid electrical power systems, autonomous functionality and digital enabled systems.

She also has in-depth knowledge of class and regulatory requirements and has held various senior roles within ABS, collaborating with various teams and widening her technical and engineering experience. Wang received a Master of Science in Electrical Engineering from the University of Akron and her prior industry experience with Cummins brought her in-depth expertise in controls/automation.

Plenary Session

Wednesday, August 2

Panel Session on Sustainable Ports

*Chairs: John Prousalidis, National Technical University of Athens
Fabio D'Agostino, University of Genova*

The electrification of ports and their transformation into smart energy hubs represents one of the most promising solutions toward the sustainable decarbonization of the maritime industry as prescribed in a series of resolutions aiming at atmospheric neutrality, e.g., those of the International Maritime Organization of UN.

Shore connection (cold ironing) being one of the key features to remove local air pollution in ports along with the integration of smart grids with green energy sources in the port distribution network are major components of this sustainable electrification effort.

Guided by the motto of IEEE “Advancing Technology for Humanity”, IEEE-SA has launched a dedicated Industry Connection Activity (the “Sustainable Maritime”, ICA-22-13) to trace the challenges raised and try to respond accordingly. Within this context, the special panel session hosted within ESTS 2023 is to address technical and regulatory issues related to the shore-to-ship power technology, the microgrid deployment both onshore and onboard, the need for new market rules for the maritime electric energy, as well as the imperative need for new standards to accelerate the development and successful implementation of all this innovative technology.

Plenary Session

Thursday, August 3

Dr. William McBride,

Professor of History USNA

Panel Session on Energy Storage Technologies for Ships

Chair: Steve Kuznetsov, Raytheon Technologies

The panel will discuss a topic of great interest to both naval and commercial marine shipbuilders/operators. Shipboard Energy Storage (SES) is becoming an increasingly important area for innovation and new applications of high-density electro-chemical, static or electro-mechanical solutions to suit upcoming higher power electrical loads. A major purpose of SES is to reduce transient loading on the ship's turbine generator for the purpose of extending prime power machinery life or allowing smaller power ratings to be implemented.

The ESTS panel will include three (3) manufacturers of competitive large-scale energy storage systems representing advanced super-capacitors, inertial flywheel rotating machine systems and advanced storage batteries. The firms will show examples of installations on commercial marine systems and how these may be applied in the next 5 years to various Navy ships.

Lunch Speaker

Wednesday, August 2

Hansueli Krattiger

ABB Marine Naval Segment

Hansueli Krattiger received his BSEE degree from Basle Engineering College in 1978 and the BWL Business degree from the School of Engineering in Bern in 1990.

Starting in 1978, his working experience includes Brown Boveri Corporation (BBC) and Asea Brown Boveri (ABB), in Switzerland and USA.



In his early career he was Developing Advanced Digital Control Systems for Power Electronics Applications, using then available microprocessors and bit-slice processors. Later he was in various positions in Sales, Business Development and Management for Power Electronics and Medium Voltage Drives, and with ABB's Technology development.

Located in USA, currently he is with the ABB Marine Naval Segment, advising on Technology. His specific focus is Power Electronic Distribution Systems and Architectures that started with the US Navy ONR PEPP Program more than 20 years ago, and extends to various advanced Integrated Power and Energy and Hybrid Architectures for Marine and Naval applications.

Lunch Speaker

Thursday, August 3

Moni Islam

Central Committee Coordinating Chairman

Moni Islam has over 50 years of experience in marine electrical engineering design, system integration, and code compliance, including projects under US Government Security Clearance. His extensive experience encompasses Integrated Power System (IPS) design, supervision, and testing, including power distribution, equipment installation, and acceptance trials.



Among his notable roles, he has served as the Planning Manager and Engineering Superintendent for the Saudi Naval Expansion Program (US Navy), the Electrical Engineering Design and Development Manager for the USCG Healy Polar Icebreaker, and a Senior Subject Matter Expert and Consultant for USCG PSC Icebreaker.

Mr. Moni Islam is advisor to the IEEE-45.1 Shipboard Power System Rewrite Committee. He has also been Central Committee Coordinating Chairman for IEEE-45 Dot Standards and the Working Group Chairman for Developing IEEE-P45.1 Standard for Shipboard Power System Design.

Furthermore, he is a Life Member of the IEEE and played a pivotal role as the initiator of the Electric Ship Technology Symposium (ESTS) conference in 2004.

Dinner Speaker

Thursday, August 3

Brennan Kelly

Brunswick Corporation

Brennan Kelly is the Electric Propulsion Analysis Engineer for Brunswick Corporation, the global leader in marine recreation. He specializes in simulation and analysis of electrified marine propulsion systems and drive components, and leads electrification research at Brunswick's iJet Innovation Lab at the University of Illinois. Prior to working at Brunswick, Brennan was a co-op for several years at Honda R&D, developing electrified vehicle prototypes and electrical framework for production vehicles. Brennan received his MS and BS in Electrical and Computer Engineering from The Ohio State University, where he was the lead graduate researcher on a DOE-sponsored project in collaboration with General Motors. No matter the form of transportation, he continues to leverage his passion for sustainability to drive and evaluate innovative electric mobility solutions.



ESTS 2023 SCHEDULE

Tuesday, August 1

8:00 am	Tutorials (Potomac)	Tutorials (Washington/Jefferson)
12:30 pm	Lunch (on your own)	
2:00 pm	Tutorial Session (Grand Ballroom)	
3:10 pm	Tutorials (Potomac)	Tutorials (Washington/Jefferson)

Wednesday, August 2

7:00 am	Breakfast (Grand Ballroom and Foyer)	
8:00 am	Opening Remarks and Keynote Address (Grand Ballroom)	
8:45 am	Plenary Session (Grand Ballroom)	
10:25 am	Coffee Break (Foyer)	
10:45 am	Technical Session (Potomac)	Technical Session (Wash/Jeff)
12:30 pm	Lunch and Lunch Address (Grand Ballroom)	
1:30 pm	Technical Session (Potomac)	Technical Session (Wash/Jeff)
3:15 pm	Coffee Break (Foyer)	
3:30 pm	Poster Session (Grand Ballroom)	
5:15 pm	Women in Engineering/Young Professionals Reception (Foyer) – ALL attendees invited	

Thursday, August 3

7:00 am	Breakfast (Grand Ballroom and Foyer)	
8:00 am	Opening Remarks and Keynote Address (Grand Ballroom)	
8:45 am	Plenary Session (Grand Ballroom)	
10:25 am	Coffee Break (Foyer)	
10:45 am	Technical Session (Potomac)	Technical Session (Wash/Jeff)
12:30 pm	Lunch and Lunch Address (Grand Ballroom)	
1:30 pm	Technical Session (Potomac)	Technical Session (Wash/Jeff)
3:15 pm	Coffee Break (Foyer)	
3:30 pm	Technical Session (Potomac)	Technical Session (Wash/Jeff)
6:00 pm	Reception and Banquet (Foyer/Ballroom)	

Friday, August 4

7:00 am	Breakfast (Grand Ballroom and Foyer)	
8:00 am	Special Session (Grand Ballroom)	
10:00 am	Coffee Break (Foyer)	
10:20 am	Technical Session (Potomac)	Technical Session (Wash/Jeff)
12:00 pm	End Symposium	

TUTORIAL PROGRAM

Tuesday, August 1

8:00 am Tutorial Session I

Supporting Sustainability in the Maritime Sector (Potomac Room)

John Prousalidis, National Technical University of Athens

Windings for AC Electric Machines (Washington/Jefferson)

David A. Torrey, GE Research

10:00 am Tutorial Session II

Wide Bandgap Device Applications (Potomac)

Michael Shur, Rensselaer Polytechnic Institute

High Temperature Superconducting Technology (Washington/Jefferson)

Sastry Pamidi / Peter Cheetham, FSU

11:30 am Tutorial Session III

IEEE 45.1 Update (Potomac)

John Amy/Norbert Doerry, NSWCPD/NSWCCD

Software-Defined Power Electronics: Theory & Study Cases (Washington/Jefferson)

Matthias Preindl, Columbia University

12:30 pm Lunch (on your own)

2:00 pm Tutorial Session IV

Design and Selection of Electric Power and Propulsion (Grand Ballroom)

Peter Mccauley, NAVSEA

3:10 pm Tutorial Session V

Cyber-Physical System Considerations in Mission-Critical Energy Applications (Potomac)

Charalambos Konstantinou / Subham Sahoo, KAUST/Aalborg University

Reflected Waves and Surge Overvoltage on Electric Machines Fed by Ultra-Fast Power Converters – Challenges and Solutions (Washington/Jefferson)

JiangBiao He / Behrooz Mirafzal, U. Kentucky / Kansas State

ESTS 2023 PROGRAM

Wednesday, August 2

7:00 am Breakfast and Networking (Grand Ballroom and Foyer)

8:00 am Opening Remarks and Keynote Address (Grand Ballroom)

J. Carey Filling, *Director for Surface Ship Design and Systems Engineering, Naval Sea Systems Command*

8:40 am Plenary Session: Sustainable Ports (Grand Ballroom)

10:45 am Technical Session A1L-A (Potomac)

Model-Based Systems Engineering: System-Level Models

Chairs: Terry Ericson, *Ericson Innovations*

Mohamad Zahzah, *Ultra EMS*

Feasibility Study of a Modular Multi-Purpose Frigate with an Integrated Power & Energy System

Luca Braidotti, Andrea Vicenzutti, Daniele Bosich, Vittorio Bucci,

Giorgio Sulligoi, Giorgio Trincas

University of Trieste, Italy

Baselining a Functional Architecture for a Power Electronic Power Distribution System for Navy Vessels

Carmen Araujo¹, David Gross¹, Michael Steurer¹, Sihun Song¹,

Christian Schegan²

¹*Florida State University, United States;* ²*Naval Surface Warfare Center, United States*

Virtual Prototyping Process: Enabling Shipboard Sizing and Arrangement of a Power Electronics Power Distribution System

Rounak Siddaiah¹, Robert M. Cuzner¹, Chaianan Sailabada², Juan Ordonez², Narayanan Rajagopal³, Christina DiMarino³, Avi Chatterjee⁴, Julie Chalfant⁴

¹*University of Wisconsin–Milwaukee, United States;* ²*Florida State University, United States;* ³*Virginia Polytechnic Institute and State University, United States;* ⁴*Massachusetts Institute of Technology, United States*

Reduced Order Model of a Four-Zone Medium-Voltage AC Electric Ship

Carl S. Greene¹, Wayne W. Weaver¹, David G. Wilson², Rush D. Robinett III¹,

Ronald C. Matthews², Steven Glover²

¹*Michigan Technological University, United States;*

²*Sandia National Laboratories, United States*

System Efficiency Model for Microgrids Using Fractional Programming

Md Isfakul Anam, Tuyen Vu, Krishna Murari, Christian Schegan,
Michael Steurer

¹Clarkson University, United States; ²Naval Surface Warfare Center,
United States; ³Florida State University, United States

10:45 am Technical Session A1L-2 (Washington/Jefferson)

Shipboard Energy Storage and Management

Chairs: Steve Kuznetsov, Raytheon

David Wetz, University of Texas Arlington

**Survivability of Battery Energy Storage Systems During
Shipboard Power Events**

J.J. Deroualle¹, J.C. Boone¹, G.A. Brik¹, P. Vos², P.J. Schutyser^{1,3}

¹Royal IHC, Netherlands; ²Eling Vos Power Systems, Netherlands;

³Seatools, Netherlands

Empirically Based Energy Storage Sizing

Hayden L. Atchison, David A. Wetz, Alexander N. Johnston,
Shawn T. Scoggin

University of Texas at Arlington, United States

**Evaluation of Tactical Energy Management Controls for
Shipboard Power Systems**

James Langston¹, Mark Stanovich¹, Harsha Ravindra¹, Michael Steurer¹,
Christian Schegan²

¹Florida State University, United States; ²Naval Surface Warfare Center,
United States

Design and Manufacture of Robust Composite Flywheels for Microgrids

S. Pish, S. Manifold, J. Hahne, J. Beno, R. Hebner

University of Texas at Austin, United States

**Optimal-Control-Based Evaluation of Shipboard Power Systems
with Energy Magazines**

Musharrat Sabah, Aaron M. Cramer

University of Kentucky, United States

12:30 pm Lunch and Lunch Address (Grand Ballroom)

Speaker: Hansueli Krattiger, ABB

1:30 pm Technical Session A2L-1 (Potomac)

**Model-Based Systems Engineering: Subsystem-Level and
Component Models**

Chairs: Marie Lawson, Ingalls Industries

Robert Cuzner, University of Wisconsin-Milwaukee

Active Thermal Control of AC/DC Power Converter Considering Health Monitoring of Power Modules

Ali Moghassemi, Gokhan Ozkan, Christopher S. Edrington,
Grace Muriithi, Zheyu Zhang
Clemson University, United States

Digital Twin Modeling of Power Electronic Converters

Kerry Sado, Jack Hannum, Kristen Booth
University of South Carolina, United States

Analytical Methods for Determining High Frequency Winding Loss for Toroidal Inductors

Todd J. Marzec¹, Ravisekhar Raju², Brandon Grainger¹, Paul R. Ohodnicki¹
¹University of Pittsburgh, United States; ²Fastwatt LLC, United States

Comprehensive Analysis and Modeling of Conventional and Hybrid Electric Ferry Power and Propulsion Systems

Shokoufeh Valadkhani, Othman Alkandri, Zhansen Akhmetov, Zeljko Pantic
North Carolina State University, United States

Trade Study Benchmarking Ferrite and Nanocrystalline Based Medium Frequency Transformer Technology with Numerical Modelling

Mohendro Kumar Ghosh¹, Chris Bracken¹, Mark Juds¹,
Bharadwaj Reddy Andapally², Brandon Grainger¹, Paul R. Ohodnicki¹
¹University of Pittsburgh, United States; ²CBMM Europe, Netherlands

**1:30 pm Technical Session A2L-2 (Washington/Jefferson)
Electric Propulsion and Generation**

Chairs: Dwight Alexander, *Northrop Grumman*
Dan Drews, *DRS Technologies*

Dynamic Load Testing of a Diesel Generator Using Power Hardware-in-the-Loop Simulation

K. Schoder¹, J. Langston¹, M. Steurer¹, H. Ravindra¹, M. Stanovich¹,
J. Hauer¹, M.R. Appannagari², Niannian Cai², K. Gubba Ravikummar²,
C. Dieken³, Ross Campbell³
¹Florida State University, United States; ²Advanced Technology Innovation, Google LLC, United States; ³Rolls-Royce Power Systems, Rolls-Royce Solutions America Inc., United States

Multiphase Multilevel NPC Converter for MVDC Electric Ship Applications

Mahdi Homaeinezhad, Omid Beik, Awais Karni
North Dakota State University, United States

Genetic Optimization of Propeller-Motor Matching for All-Electric Ships

Cristofer Hood Marques^{1,2}, Juan C. Ordenez², Jeferson Avila Souza¹,
Jean-David Caprace³
¹Universidade Federal do Rio Grande, Brazil; ²Florida State University, United States; ³Universidade Federal do Rio de Janeiro, Brazil

Real Time Condition Monitoring of Electric Propulsion and Generation System Using Passive Battery-Free RF Temperature Sensor
Reamonn Soto, Joshua McConkey, Swadipta Roy, Sreekala Suseela, Taofeek Orekan
Sensatek Propulsion Technology, Inc., United States

Thrusters Availability Influence on DP MODU Fuel Oil Consumption
Felipe de Alcântara Vieira, Vinícius Athouguia Gama
Petrobras S/A, Brazil

3:30 pm Poster Session A3P3 (Grand Ballroom)

ESTS 2023 Poster Session

Chairs: Raghav Khanna, *The University of Toledo*
Andy Lemmon, *The University of Alabama*

Digital Twin Approach Enables Switching Converter Adaptive Control for All-Electric Ship Power Distribution System
Andy Wong, Jared Cronin, Enrico Santi
University of South Carolina, United States

Dynamic Modeling and Simulation of Thermal-Electrical Energy Systems in MVDC All-Electric Ships with Small Modular Reactors
Soroush Senemmar, Sobhan Badakhshan, Jie Zhang
University of Texas at Dallas, United States

A Survey on Pulse Power Load Applications and Tools for Simulation
F. D'Agostino¹, D. Kaza¹, F. Silvestro¹, A. Chiarelli², F. Olcese²
¹*University of Genova, Italy;* ²*Fincantieri S.p.A., Italy*

Launching Systems for Unmanned Vehicles Onboard Naval Vessels
Nicola Norcia, Luca Braidotti, Serena Bertagna, Vittorio Bucci, Alberto Marinò
University of Trieste, Italy

Distributed Optimal Power Flow for a Standalone All-Electric Ship Using Asynchronous ADMM
Lalit Kishore Marepalli, Luis Herrera
State University of New York at Buffalo, United States

Next Generation Amphibious Vessel: An Innovative Power and Propulsion System
Nicola Norcia, Luca Braidotti, Serena Bertagna, Vittorio Bucci, Alberto Marinò
University of Trieste, Italy

MVDC Marine: From Customer Needs to Technical Requirements, Product Gaps, Potential Solutions
Li Lisa Qi¹, John Lindtjorn², Hans Krattiger¹
¹*ABB Inc, United States;* ²*ABB AS, Norway*

Measurement System for Insulation Performance Investigation of Graphite Polluted Insulator Material Under High Voltage DC

Christoph Diendorfer¹, Peter Zeller¹, Matthias Musil¹,
Christian Gruberbauer¹, Mischa Steurer²

¹*FH OOE Upper Austria Research & Development, Austria;*

²*Florida State University, United States*

All-Electric Ship On-Board Continuous Sustainable H2 Generation from Aluminum Scrap and Seawater

Dhyogo M. Taher¹, Wellington Balmant¹, Stephan H. Och¹,

Diogo B. Pitz¹, Giuliana S. Venter¹, Lucio C. Filho²,

Lauber S. Martins³, José V.C. Vargas⁴, Juan C. Ordonez⁴

¹*Universidade Federal do Paraná, Brazil;* ²*Universidade Estadual de Maringá, Brazil;* ³*Advent Health University, United States;*

⁴*Florida State University, United States*

SC-MMC Controller Validation Using a CHILplug Interface

Isabel Barnola, Mark Stanovich, Karl Schoder, Sihun Song,

Michael Mischa Steurer

Florida State University, United States

Decarbonization of the Maritime Transportation Systems: Recent Progress, Challenges, and Prospects

Tugce Uslu Aktas¹, Jian Shi¹, Gino J. Lim¹, John Prousalidis²,

Fabio D'Agostino³, Chengji Liang⁴

¹*University of Houston, United States;* ²*National Technical University of Athens, Greece;* ³*University of Genova, Italy;* ⁴*Shanghai Maritime University, China*

Hybrid and Solid State Circuit Breakers

Marcel P.J. Gaudreau, David Cope, Joe Harbour, Shannon Hunter,

Susie Eustis, Robert Phillips, Michael Kempkes, Rebecca Simpson

Diversified Technologies, Inc., United States

Integrated Power Node Center

David B. Cope, Andre Walker, Marcel Gaudreau, Neal Butler,

Tom Nguyen, Tuan Nguyen, Michael Kempkes, Rebecca Simpson

Diversified Technologies, Inc., United States

Enhancement of the Li-Ion Battery Energy Management by Real-Time Detecting the Lithium Plating Through the Analysis of the Battery Impedance

Evangelos Tsioumas, Nikolaos Jabbour, Dimitrios Papagiannis,

Christos Mademlis

Aristotle University of Thessaloniki, Greece

Assessment of Port Resilience: An Analytical Framework Based on Transportation and Electrical Power Network Coupling

Jialei Zhang¹, Chengji Liang¹, Jian Shi², Gino J. Lim², Yang Pan¹,
Kailai Wang², Sasha Zhijie Dong²

¹Shanghai Maritime University, China; ²University of Houston, United States

Sensor Limited LQG/LTR Controller for a Subscale Aircraft Arrestment System with Nonlinear Dynamics

Yacine Boudria¹, Raymond B. Sepe Jr.¹, Steven P. Bastien¹, Musa Jouaneh²

¹Electro Standards Laboratories, United States; ²University of Rhode Island, United States

5:15 pm Women in Engineering and Young Professionals Reception (all invited) (Foyer)

Thursday, August 3

7:00 am Breakfast and Networking (Grand Ballroom and Foyer)

8:00 am Opening Remarks and Keynote Address (Grand Ballroom)

Jin Wang, Director of Technology within the Corporate Technology Department at the American Bureau of Shipping (ABS)

8:40 am Plenary Session: Energy Storage Technologies for Ships (Grand Ballroom)

**10:45 am Technical Session B1L-1 (Potomac)
Hardware Modeling and Digital Twins**

Chairs: Terry Ericson, *Ericson Innovations, LLC*
Mohamad Zahzah, *Ultra EMS*

Fast System Level Model for Digital Twin Based Optimization of Naval Power and Energy System

Jared Cronin¹, Enrico Santi¹, Andrew Wunderlich², Joshua Knight²

¹University of South Carolina, United States;

²Integer Technologies, LLC, United States

Determining Parameter Objectives via Model-Based Engineering

Robert M. Cuzner¹, David C. Gross², Rounak Siddaiah¹,

Julie Chalfant³, Mischa Steurer², Naqash Ali²

¹University of Wisconsin–Milwaukee, United States; ²Florida State University, United States; ³Massachusetts Institute of Technology, United States

Hardware Simulation of a Multiphysics Ship Machinery System for Autonomous Machinery Research

Stephen A. Olson, Timothy J. McCoy, Micah Williamson,
Henry Zayko, Arianna Kerkmaz
University of Michigan, United States

Hardware Modeling of Diesel Engine Fuel System Failure Modes and Coupled Shipboard Dynamics

Ethan T. Almquist, Timothy J. McCoy, Stephen A. Olson,
Arianna Kerkmaz, Micah Williamson, Henry Zayko
University of Michigan, United States

Digital Twin Model for Predicting the Thermal Profile of Power Cables for Naval Shipboard Power Systems

Kerry Sado, Richard Hainey, Jose Peralta, Austin Downey, Kristen Booth
University of South Carolina, United States

10:45 am Technical Session B1L-2 (Washington/Jefferson)

Battery Management and Pulsating Loads for Shipboard Systems

Chairs: Steve Kuznetsov, Raytheon

David Wetz, *University of Texas Arlington*

Novel Rate-Limited Droop Control for DC Distribution with Impulsive Loads

Andrew Wunderlich¹, Andy Wong², Jared Cronin², Enrico Santi²
¹*Integer Technologies, LLC, United States;*
²*University of South Carolina, United States*

Advanced Load Shed and Predictive Ramp Rate Control of a Medium Voltage AC/DC Testbed

Cole Tschritter¹, Alexander Johnston¹, David Wetz¹, Linh Vu², Tuyen Vu²,
Thanh Nguyen², James Langston³, Harsha Ravindra³, Karl Schoder³,
Mark Stanovich³, Mischa Steurer³, Christian Schegan⁴, John Heinzl⁴
¹*University of Texas at Arlington, United States;* ²*Clarkson University, United States;* ³*Florida State University, United States;* ⁴*Naval Surface Warfare Center, United States*

Model Predictive Control for the Operation of a Hybrid MVAC and MVDC Electric Warship

Joseph Young¹, Marvin A. Cook², David G. Wilson², Wayne Weaver³
¹*OptimoJoe, United States;* ²*Sandia National Laboratories, United States;*
³*Michigan Technological University, United States*

Dynamic Modeling and Reliable Operation of All-Electric Ships with Small Modular Reactors and Battery Energy Systems

Sobhan Badakhshan, Soroush Senemmar, Jie Zhang
University of Texas at Dallas, United States

Progress Towards a Coupled Electro-Thermo Battery Emulator

Jarrett Peskar, Austin R.J. Downey, Jamil Khan, Kristen Booth
University of South Carolina, United States

12:30 pm Lunch and Lunch Address (Grand Ballroom)

Speaker: Moni Islam, IEEE

1:30 pm Technical Session B2L-1 (Potomac)

Packaging and Thermal Considerations for Power Conversion

*Chairs: Patrick Lewis, GE Power Portfolio
Brandon Grainger, University of Pittsburgh*

Performance Demonstration of a Dropwise Vapor Chamber for Highly Efficient Heat Spreading for Power Electronics

Kai Luo, Chen Li, Enrico Santi
University of South Carolina, United States

Impact of Pressure Profile on Contact Resistance Using PGS in iPEBB Cooling

Joshua Padilla, Ethan Lietch, Julie Chalfant, Chryssostomos Chryssostomidis
Massachusetts Institute of Technology, United States

Organic Substrates for SiC-Based PEBB Power Modules: Challenges and Opportunities

Narayanan Rajagopal, Christina DiMarino
Virginia Polytechnic Institute and State University, United States

A History of Silicon Carbide (SiC) Wide Bandgap (WBG) Advancement Through Power Electronic Building Blocks (PEBB) and Implications for the Future

LJ Petersen
Office of Naval Research, United States

Multi-Objective Co-Design of an Integrated Power Electronics Building Block

Marie Lawson, Narayanan Rajagopal, Taha Moaz, Vladimir Mitrovic, Dong Dong, Christina DiMarino
Virginia Polytechnic Institute and State University, United States

1:30 pm Technical Session B2L-2 (Washington/Jefferson)

Dielectric Challenges for Shipboard Systems

*Chairs: Chanyeop Park, University of Wisconsin-Milwaukee
Hua Zhang, Rowan University*

Mitigating Space Charge Accumulation at Various Temperatures Using Electrets

Pradip Chandra Saha, Omar Faruque, Chanyeop Park
University of Wisconsin-Milwaukee, United States

**Innovative Design of Laminated Bus Bars for Electrical Ships:
Three-Leg Approach**

G.C. Montanari¹, S. Schwartz², R. Cuzner², S. Kolesar³

¹Florida State University, United States; ²University of Wisconsin–
Milwaukee, United States; ³Naval Surface Warfare Center, United States

**Insulation Tester for Medium Voltage Components Subject to
PWM Voltage Stress**

Jesse Leonard¹, Ravisekhar Raju¹, Karim Younsi², Han Xiong²

¹Fastwatt LLC, United States; ²GE Research, United States

Mitigating Partial Discharge in PWM Voltage Systems Using Electrets

Farhina Haque¹, Omar Faruq², Chanyeop Park²

¹Sweet Briar College, United States;

²University of Wisconsin–Milwaukee, United States

**DC Arc Flash Measurement from Valve-Regulated
Lead Acid (VRLA) Batteries**

Nicolaus E. Jennings¹, David A. Wetz¹, Rick Langley², John M. Heinzel³

¹University of Texas at Arlington, United States; ²Electric Power Research
Institute, United States; ³Naval Surface Warfare Center, United States

3:30 pm Technical Session B3L-1 (Potomac)

Power Distribution, Cabling, and Thermal Considerations

Chairs: Patrick Lewis, GE Power Portfolio

Timothy McCoy, University of Michigan

Laminated Bus Bars: Safety and Reliability in New Maritime Applications

Thomas Fouet¹, Thomas A. Petote², Thomas A. Giuliano²

¹Mersen, France; ²Mersen, United States

**Thermal Management Approaches for Power Electronic Building
Blocks and Power Corridors**

J.C. Ordonez^{1,2}, C. Sailabada¹, J. Chalfant², C. Chrysostomidis², C. Li³, K. Luo³,

E. Santi⁴, B. Tian⁴, A. Biglo⁴, N. Rajagopal⁵, J. Stewart⁵, C. DiMarino⁵

¹Florida State University, United States; ²Massachusetts Institute of

Technology, United States; ³University of South Carolina, United States;

⁴Virginia Polytechnic Institute and State University, United States

**Graph Based Power Flow Algorithm for Single Phase Radial and
Weakly Meshed Distribution System in the Presence of
Distributed Generations**

Krishna Murari¹, Tuyen Van Vu¹, Md Isfakul Anam¹,

James Langston², Michael Steurer²

¹Clarkson University, United States; ²Florida State University, United States

A Comparison of Thermal Management Design Tools S3D and ATTMO
Grant Oh¹, Julie Chalfant¹, Rodrigo Leonard², Richard Smart²,
Kevin McCarthy³, Patrick McCarthy³
¹Massachusetts Institute of Technology, United States; ²University of South Carolina, United States; ³PC Krause and Associates, United States

State Estimation for Power Distribution System Using Graph Neural Networks

Quang-Ha Ngo¹, Bang L.H. Nguyen², Tuyen V. Vu¹, Tuan Ngo³
¹Clarkson University, United States; ²Los Alamos National Laboratory, United States; ³Entrust Solutions Group, United States

**3:30 pm Technical Session B3L-2 (Washington/Jefferson)
Power System Control Methods and Architectures**

Chairs: Giorgio Sulligoi, *University of Trieste*
Ali Davoudi, *University of Texas Arlington*

A Cross-Current Compensation Control Scheme to Improve Voltage Regulation and Power Sharing in DC Shipboard Microgrids

F. D'Agostino, F. Silvestro, F. Sivori
University of Genova, Italy

A Stability-Aimed PMS for Shipboard Zonal DC Microgrids: The C-HIL Tests on Real-Time Platform

Andrea Alessia Tavagnutti, Massimiliano Chiandone,
Daniele Bosich, Giorgio Sulligoi
University of Trieste, Italy

Numerical Challenges for Market Clearing in Power Electronics-Based Power Distribution Systems

Musharrat Sabah, Aaron M. Cramer, Isuje T. Ojo
University of Kentucky, United States

Introduction of Posture-Based Pre-Alignment for Naval Applications

Kristen Booth¹, Kerry Sado¹, Jack Hannum¹, Joshua Knight², Roger Dougal¹
¹University of South Carolina, United States;
²Integer Technologies, LLC, United States

Modeling and Performance Enhancement of Tidal Energy Based Seaport Microgrid for Shipboard Loads Using DSTATCOM

Deepi Singh, Abdul Wasay, Kushan Choksi, Fang Luo
State University of New York at Stony Brook, United States

6:00 pm Reception and Banquet (Grand Ballroom)

Dinner Speaker: Brennan Kelly, Brunswick Corp.

Friday, August 4

7:00 am Breakfast and Networking (Grand Ballroom and Foyer)

8:00 am Special Session (Grand Ballroom)
**Modeling Shipboard Power Systems for Endurance
Fuel and Annual Fuel Calculations**

Chairs: John Amy, *NSWCPD/NSWCCD*
Norbert Doerry, *NSWCPD/NSWCCD*

10:20 am Technical Session C1L-1 (Potomac)
Protection, Reconfiguration, and Electromagnetic Interference

Chairs: Ben Ford, *Hepburn and Sons*
Jian Shi, *University of Houston*

**Investigation of SiC MOSFET Aging Effects on
Common-Mode EMI Emissions**

Tahmid Ibne Mannan, Ashik Amin, Seungdeog Choi
Mississippi State University, United States

**A Multi-Objective Optimization for the Power Management of
Shipboard Zonal DC Microgrids**

Andrea Alessia Tavagnutti, Daniele Bosich, Andrea Vicenzutti,
Valentino Pediroda, Giorgio Sulligoi
University of Trieste, Italy

Shipboard Energy System Resiliency Evaluation and Application

Angelo Ferraro, Herbert L. Ginn
University of South Carolina, United States

**A Nonlinear Inductor-Based Fault Current Commutation Strategy to
Enable Zero-Current Opening of the Mechanical Switch in a
Hybrid DC Circuit Breaker**

Qichen Yang¹, Michael Steurer¹, Yanjun Shi², Sihun Song¹, Nash Bonaventura¹,
Yuchen He¹, John Hauer¹, Matthew Bosworth¹, Lukas Graber³
¹*Florida State University, United States;* ²*Tesla, Inc., United States;*
³*Georgia Institute of Technology, United States*

**Analysis and Cancellation of Common-Mode Voltage
in the Buck Converter**

Jared C. Helton¹, Andrew N. Lemmon¹, Aaron D. Brovont²
¹*University of Alabama, United States;*
²*PC Krause and Associates, United States*

10:20 am Technical Session C1L-2 (Washington/Jefferson)

Cyber-Physical System Considerations

Chairs: Cheng Siong Chin, *Newcastle University*
Karl Schoder, *Florida State University*

**Impact Assessment of Data Integrity Attacks in
MVDC Shipboard Power Systems**

Kirti Gupta¹, Subham Sahoo², Bijaya Ketan Panigrahi¹,
Charalambos Konstantinou³

¹*Indian Institute of Technology Delhi, India;* ²*Aalborg University, Denmark;*
³*King Abdullah University of Science and Technology, Saudi Arabia*

**Security Enhancement of Cyber-Physical DC Ship Power System
Using Scalable Deep Learning Method**

Grace Muriithi, Behnaz Papari, Ali Moghassemi, Ali Arsalan,
Gokhan Ozkan, Christopher Shannon Edrington
Clemson University, United States

**Stochastic Characterization-Based Performance Analysis of an
Emulated Communication Network for Cyber-Physical
Shipboard Power Systems**

Mahmoud S. Abdelrahman, Tung-Lam Nguyen, Osama A. Mohammed
Florida International University, United States

**Lost at Sea: Assessment and Evaluation of Rootkit Attacks on
Shipboard Microgrids**

Suman Rath¹, Andres Intriago², Shamik Sengupta¹, Charalambos Konstantinou²

¹*University of Nevada, Reno, United States;* ²*King Abdullah University of
Science and Technology, Saudi Arabia*

**Implementation of IEEE C37.118 Packet Manipulation Tool,
pySynphasor for Power System Security Evaluation**

Shuvangkar Chandra Das, Tuyen Vu, Herbert Ginn, Karl Schoder

¹*Clarkson University, United States;* ²*University of South Carolina, United
States;* ³*Florida State University, United States*

12:00 pm End of Conference

NOTES