Welcome Message

Welcome to the 2017 Electric Ship Technology Symposium. On behalf of the 2017 ESTS organizing committee, we would like to thank each and every one of the attendees for coming to this meeting where we will exchange ideas on the future of electric ship technologies. The first Electric Ship Technology Symposium began in 2005, largely as a result of U.S. Navy interest in electric ships, an interest which has grown over the subsequent years. So to this end, we particularly thank the U.S. Navy and the U.S. Office of Naval Research for their support of this technical area over the years. But of course, interest in electric ships is not limited to the U.S. Navy, or even the navies of the world; indeed electric ship technology is of strong interest in many civilian maritime applications, and so the range of contributors to this technology is very diverse. Thus it is our goal that this conference welcomes all who are interested in electric ships to both learn and contribute new technical knowledge to this growing area.

This year we have had a change in format to the conference. In addition to the keynote speakers, the panel sessions, the technical sessions, and the poster sessions, we offer tutorials on the day preceding the conference proper. We hope that this will be of value to you. Even if you are unable to attend these, please note that your USB memory stick includes all the tutorial presentations, in addition to the papers.

As we collectively participate in this year’s symposium, please be aware of the generous support provided by our six platinum sponsors – General Atomics, L3, Northrop Grumman, OPAL-RT, RTDS, and Typhoon-HIL. Please be sure to visit their booths during the conference as they are all important contributors to electric ship technology.

The technical committee also thanks the IEEE Power and Energy Society and the IEEE Power Electronics Society for technical and financial sponsorship of this conference, without which the conference would have been impossible. The committee also thanks the IEEE Transportation Electrification Community for helping to advertise this event. Finally, we hope that each of you will find the conference to be enjoyable, stimulating, and enlightening.

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Chair, ESTS 2017

Prof. Michael Mazzola
Co-chair, ESTS 2017
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Mischa Steurer – Florida State University

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Aaron Cramer, University of Kentucky
Norbert Doerry, Naval Sea Systems Command (SEA 05TD)
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Marie Lawson, Ingalls Industries – Newport News Shipbuilding
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The Marine Systems business unit of Northrop Grumman's Mission Systems sector provides engineered propulsion, power generation and missile launch systems to the U.S. Navy. Marine Systems provides cradle-to-grave support beginning with concept studies, progressing through the full design cycle, continues with prototype and production hardware manufacture and test, and culminates with robust field support around the globe. Marine Systems currently provides propulsion, power generation and missile launch solutions to the VIRGINIA Class and COLUMBIA Class submarines and propulsion and power generation systems to the FORD Class aircraft carriers.

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Rear Admiral William J. Galinis
PROGRAM EXECUTIVE OFFICER, SHIPS

Rear Adm. William Galinis is a native of Delray Beach, Florida. He is a 1983 graduate of the U.S. Naval Academy where he received a Bachelor of Science in Electrical Engineering. He holds a Master of Science in Electrical Engineering from the Naval Post Graduate School. Galinis’ tours as a surface warfare officer included damage control assistant aboard USS Vreeland (FF 1068) and engineer officer aboard USS Roark (FF 1053). He was selected for transfer to the engineering duty officer community in September 1991.

Galinis’ initial engineering duty tour was with the supervisor of Shipbuilding, Conversion and Repair, New Orleans, where he worked on both new construction and repair projects including assignment as the PMS 377 program manager’s representative for the LSD (CV) Shipbuilding Program. He subsequently served as the senior damage control inspector for the Board of Inspection and Survey, Surface Trials Board as well as in a number of program office and staff positions including the DD 21 and LPD 17 Program Offices and in the Office of the Deputy Assistant Secretary of the Navy for Shipbuilding as the chief of staff.

Galinis’ first flag assignment was deputy commander for surface warfare, Naval Sea Systems Command (NAVSEA 21)/commander, Navy Regional Maintenance Center, responsible for managing critical modernization, maintenance, training, Foreign Military support contracts and inactivation programs.

Currently, Galinis is serving as program executive officer, Ships, where he is responsible for Navy shipbuilding for surface combatants, amphibious ships, logistics support ships, support craft and related foreign military sales.

Galinis has received various personal, unit and service awards including three Navy Battle “E” awards.
Mr. Hanninen works for ABB Inc. Marine and Ports business unit in Houston, TX, USA. His position is in ABB global sales team as responsible for icebreaking vessels. Mr. Hanninen is specialized in podded electric propulsion for icebreakers. He has a M.Sc. (Nav. Arch.) degree in Mechanical Engineering, Ship Building department from the Helsinki University of Technology, Finland. He has also work for Helsinki University Ship laboratory as research scientist and assistant lecturer in courses of ships ice loads and winter navigation. During the last 15 years he has published more than 30 conference papers and reports related to arctic marine technology.
Lunch Speaker
Tuesday August 15

Lynn J. Petersen
PROGRAM OFFICER, OFFICE OF NAVAL RESEARCH (ONR)

Mr. Petersen graduated from the United States Naval Academy, Annapolis, MD with a BS in Mathematics in 1986 and was commissioned an Ensign in the United States Navy. Selected for lateral transfer to the Engineering Duty Officer program, he received his MS in Mechanical Engineering from the Naval Postgraduate School, Monterey, CA in 1994. Following Active Duty, he was employed by the Naval Surface Warfare Center, Carderock Division, Annapolis, MD as an Electrical Engineer. From 1998-2002, he led several projects supporting Navy Electric Drive and authored several papers and reports on electrical propulsion, conversion, generation and distribution. In October, 2002, he was detailed to the Office of Naval Research (ONR), and in May, 2006 he was hired by ONR and served as the ONR S&T rep to the Electric Ships Office, PMS 320. In November, 2008, he was recalled to Active Duty with assignment as the Deputy Director, Electric Ships Office, PMS 320, where he served from 2008-2012. While in that assignment, he was promoted to the rank of Captain in 2009, later retiring from the military in 2016 following 30 years of service in the Navy.

From 2012-2014, he was the Navy’s Director for Systems Engineering in the Deputy Assistant Secretary of the Navy (DASN) office for Research, Development, Test and Evaluation (RDT&E)

Following return back to ONR from DASN (RDT&E), Mr. Petersen serves as a Program Officer at ONR where he leads basic research in power electronics, electromagnetism, and adaptive controls and applied research in machinery controls, Silicon Carbide (SiC) Wide Bandgap (WBG) semiconductor applications and Medium Voltage Direct Current (MVDC) power distribution systems.

He is married to Alena and they have two adult children. He is a member of IEEE, American Society of Naval Engineers and the Materials Research Society. He and his wife are active in their church and singing.
Ed Zivi began his civilian naval career as a Naval Surface Warfare Center, Annapolis cooperative education student graduating from Virginia Tech. with a B.S in Engineering Science & Mechanics in 1975. Following graduation, Ed developed a first principles submarine emergency deballasting model and system simulation, including heat transfer, momentum transfer, and real gas effects with coupled submarine 6 degree-of-freedom vehicle dynamics. Following full-scale experimental validation of this Sub Safe work, Ed’s research focused on multidisciplinary analysis, modeling and simulation of advanced shipboard machinery systems. Ed enrolled in graduate studies at the University of Maryland receiving his M.S. and Ph.D. in Mechanical Engineering with a controls systems emphasis in 1983 and 1989, respectively. Working as the Technical Director for the NAVSEA Standard Monitoring and Control System, Ed developed and qualified a new generation of COTS based shipboard machinery control systems. When the Annapolis laboratory closed, Ed accepted an Assistant Professor position in the U. S. Naval Academy’s Weapons & Systems Engineering Department teaching control systems and embedded computers. Ed managed the Cyber Systems major electives developing new courses in advanced microcontrollers, Cyber-Physical Systems and the Internet of Things. At the Office of Naval Research’s request, Ed formulated the ONR Control Challenge problem and represented ONR in a collaborative electric power research solicitation with the National Science Foundation. Ed’s is active in the ONR Electric Ship Research & Development Consortium research community where he also served as a member of the board of directors. Ed’s primary research focus is resilient cyber-physical systems, primarily electric warships. Ed retired from his Naval Academy position of Professor of Control Systems Engineering in June 2017 after 46 years of Federal service.
Professor Chryssostomidis was educated in Newcastle-Upon-Tyne (B.Sc. Hns. 1965) and MIT (Ph.D. 1970) in the area of ship systems analysis. He joined the MIT faculty in 1970 and retired in February 2017. During his tenure at MIT, he served as the NAVSEA Research Professor (1985 – 1987), as the Professor of Teaching Innovation (1991 – 1993), as the Doherty Professor of Ocean Science and Engineering from 1993 until his retirement, as the Department Head of Ocean Engineering (1994 – 2002) and as the Director of MIT Sea Grant College Program, an MIT multidisciplinary laboratory, from 1982 until his retirement. Professor Chryssostomidis is the author and co-author of over 200 publications in research and education. He is best known for his excellence in mentoring students and helping them with their careers. MIT and his students recognized this by creating the Chryssostomos (1970) and Marge Chryssostomidis Fellowship Fund to help with the education of future generation of students.
# ESTS 2017 SCHEDULE

### Monday, August 14

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>8:00 am</td>
<td>Tutorial Sessions (Jefferson 1/2)</td>
</tr>
<tr>
<td>12:00 pm</td>
<td><strong>Lunch</strong> (On Your Own)</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Tutorial Sessions (Jefferson 1/2)</td>
</tr>
<tr>
<td>6:30 pm</td>
<td>Welcome Reception (Atrium)</td>
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### Tuesday, August 15

<table>
<thead>
<tr>
<th>Time</th>
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<tbody>
<tr>
<td>7:00 am</td>
<td><strong>Breakfast</strong> (Jefferson 1/2)</td>
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<tr>
<td>8:00 am</td>
<td><strong>Opening Remarks and Keynote Address</strong> (Jefferson 1/2)</td>
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<tr>
<td>8:45 am</td>
<td>Plenary Session 1: Electrification Across Industries (Jefferson 1/2)</td>
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<tr>
<td>10:25 am</td>
<td><strong>Coffee Break</strong></td>
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<tr>
<td>10:45 am</td>
<td>Technical Session (Jefferson 1/2) Technical Session (Jefferson 1/2)</td>
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<tr>
<td>12:30 pm</td>
<td><strong>Lunch and Lunch Address</strong> (Jefferson 1/2)</td>
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<tr>
<td>1:45 pm</td>
<td>Technical Session (Jefferson 1/2) Technical Session (Jefferson 1/2)</td>
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<tr>
<td>3:30 pm</td>
<td><strong>Coffee Break</strong></td>
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<tr>
<td>3:45 pm</td>
<td>Dialogue Session</td>
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<tr>
<td>5:15 pm</td>
<td>End Technical Program</td>
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### Wednesday, August 16

<table>
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<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:00 am</td>
<td>Breakfast (Jefferson 1/2)</td>
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<tr>
<td>8:00 am</td>
<td>Keynote Address (Jefferson 1/2)</td>
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<tr>
<td>8:30 am</td>
<td>Plenary Session 2: Electrification at Sea (Jefferson 1/2)</td>
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<tr>
<td>10:10 am</td>
<td>Coffee Break</td>
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<tr>
<td>10:30 am</td>
<td>Technical Session</td>
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<tr>
<td>12:15 pm</td>
<td>Lunch (Jefferson 1/2)</td>
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<td>1:30 pm</td>
<td>Technical Session</td>
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<td>3:15 pm</td>
<td>Coffee Break</td>
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<tr>
<td>3:30 pm</td>
<td>Technical Session</td>
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<tr>
<td>5:10 pm</td>
<td>Break</td>
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<tr>
<td>6:40 pm</td>
<td>Dinner (Jefferson 1/2)</td>
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### Thursday, August 17

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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<tbody>
<tr>
<td>7:15 am</td>
<td>Breakfast (Jefferson 1/2)</td>
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<tr>
<td>8:00 am</td>
<td>Technical Session</td>
</tr>
<tr>
<td>10:05 am</td>
<td>Coffee Break</td>
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<tr>
<td>10:20 am</td>
<td>Technical Session</td>
</tr>
<tr>
<td>12:00 am</td>
<td>End Symposium</td>
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</tbody>
</table>
Monday, August 14

8:00 am  Tutorial Session 1

Electric Ship Power and Energy System Architectures (Jefferson 1)
Norbert Doerry, NAVSEA, United States
John Amy, NSWC Philadelphia, United States

Electric Ship Software Developed within ESRDC (Crystal 5/6)
Julie Chalfant, Massachusetts Institute of Technology
Scott Sudhoff, Purdue University
Juan Ordonez, Florida State University
Xianyong Feng, University of Texas at Austin
Blake Langland, University of South Carolina

Modeling, Measurement, and Management of Conducted EMI and Common Mode Behavior in Shipboard Power Systems (Jefferson 2)
Aaron Brovont, University of Alabama
Andrew Lemmon, University of Alabama
Matthew Bosworth, Florida State University CAPS

1:00 pm  Tutorial Session II

Pulsed Alternator (Jefferson 1)
Scott Pish, University of Texas Center for Electromechanics
Jon Hahne, University of Texas Center for Electromechanics
Angelo Gattozzi, University of Texas at Austin

High Temperature Superconducting Technology for Electric Ships (Jefferson 2)
Sastry Pamidi, Florida State University
Lukas Graber, Georgia Tech

Electric Ship Software Developed within ESRDC (Crystal 5/6)
Julie Chalfant, Massachusetts Institute of Technology
Scott Sudhoff, Purdue University
Juan Ordonez, Florida State University
Xianyong Feng, University of Texas at Austin
Blake Langland, University of South Carolina

6:30 pm  Welcome Reception - Atrium
Tuesday, August 15

7:00 am  Breakfast (Jefferson 1/2)

8:00 am  Opening Remarks and Keynote Address (Jefferson 1/2)

8:45 am  A1L-P (Jefferson 1/2)
Electrification Across Industries  
Chair: Timothy McCoy, McCoy Consulting LLC

Rolls-Royce Transformation Journey to Embrace Electric Technology  
Kevin Daffey, Director for Engineering & Technology, Rolls Royce Marine Business

Vehicle Electrification in the Automotive Industry  
Patrick Davis, Vice-President, Strategic Marking Innovations

Electrification and Optimization of Next Generation Platforms with High Performance SiC Power Electronics  
Ty McNutt, Director of Business Development, Wolfspeed

The Convergence of Electric Technologies in Future Warship and Other Industrial Applications  
Michael Maughan, Director, Advanced Programs & Strategic Development, General Atomics

10:25 am  Coffee Break

10:45 am  A1L-A (Jefferson 3)
Electric Ship Design Tools for MVDC  
Chair: Terry Ericson, Ericson Innovations, LLC

Design Paradigm for Power Electronics-Based DC Distribution Systems  
Harish Suryanarayana, Scott Sudhoff

Incorporation of Control Systems in Early Stage Conceptual Ship Designs  
Herbert L. Ginn, Enrico Santi, Blake Langland, Angelo Ferraro, Silvia Arrua, Hessamaldin Abdollahi

Control System Modeling in Early-Stage Simulation for Cyber Vulnerability Assessment  
Allen W. Flath III, Aaron M. Cramer, Xiao Liu

Impact of Switching Frequency and Edge Rates on Common-Mode Current in MVDC Microgrids  
Aaron D. Brovont, Steven D. Pekarek

Co-Simulation of Electric Ship Power and Control Systems using High Performance Computing  
Michael S. Mazzola, Tomasz Haupt, Gregory Henley, Angela Card, Jian Shi
10:45 am  A1L-B (Crystal 5/6)
DC Fault Protection and Other Topics
Chair: Harish Suryanarayana, ABB Inc

DC Fault Current Control of Modular Multilevel Converter with SiC-Based Power Electronics Building Blocks
Jianghui Yu, Rolando Burgos, Niloofar Rashidi Mehrabadi, Dushan Boroyevich

Comparative Study of the DC-DC Power Conversion Module based on Dual Active Bridge Converter and Modular Multilevel Converter for Shipboard MVDC System
Ren Xie, Ran Mo, Yanjun Shi, Hui Li

AC-DC Interface Converters for MW-Scale MVDC Distribution Systems: A Survey
Daniele Bosich, Rosa Anna Mastromauro, Giorgio Sulligoi

Effects of Parasitic Inductance on Performance of 600-V GaN Devices
Andrew J. Sellers, Cheikh Tine, Roshan L. Kini, Michael R. Hontz, Raghav Khanna, Andrew N. Lemmon, Ali Shahabi, Christopher New

A Feeder Protection Method Against the Phase-Phase Fault using Symmetrical Components
Catalin Iosif Ciontea, Claus Leth Bak, Frede Blaabjerg, Kjeld Kilsgaard Madsen, Claes

12:30 pm  Lunch

1:45 pm  A2L-A (Jefferson 3)
Cabling, Grounding, and Common-Mode Current
Chair: Michael Mazzola, Mississippi State University

MVDC Grounding and Common Mode Current Control
Norbert H. Doerry, John V. Amy Jr.

A Coupled Thermal/Electric Circuit Model for Design of MVDC Ship Cables
Xiang Zhang, Steven Pekarek

Common-Mode Equivalent Modeling of a Notional Two-Zone MVDC Ship Power System
M. Bosworth, H. Ravindra, M. Steurer, S. Pekarek

Common-Mode/Differential-Mode Interactions in Asymmetric Converter Structures
Aaron D. Brovont, Andrew N. Lemmon

Modular Integrated Power Corridor
C.M. Cooke, C. Chryssostomidis, J. Chalfant
1:45 pm  A2L-B (Crystal 5/6)
Electric Ship Design Tools for Early-Stage Ship Design
Chair: Norbert Doerry, Naval Sea Systems Command (SEA 05TD)

Using S3D to Analyze Ship System Alternatives for a 100 MW 10,000 Ton Surface Combatant
Richard Smart, Julie Chalfant, John Herbst, Blake Langland, Angela Card, Rod Leonard, Angelo Gattozzi

Smart Ship System Design (S3D) Integration with the Leading Edge Architecture for Prototyping Systems (LEAPS)
Julie Chalfant, Blake Langland, Douglas Rigterink, Cullen Sarles, Peter McCauley, David Woodward, Alan Brown, Robert Ames

Application of Templates to Early-Stage Ship Design
Julie Chalfant, Chryssostomos Chryssostomidis

Power Converter Metamodeling Approach for the Smart Ship Design Environment
Robert Cuzner, Shaun Cruz, Frank Ferrese, Rasoul Hosseini

Automatic Synthesis of Detailed Designs from Early-Stage Conceptual Designs
Blake Langland, Rodrigo A. Leonard, Helder Pais, R.A. Dougal

3:30 pm   Coffee Break

3:45 pm   Dialogue Session (TBD)
Chair: Rolando Burgos, Virginia Tech

High-Speed Simulation of Modular Multilevel Converters for Optimization based Design
Raj Sahu, Scott D. Sudhoff

Application of STATCOM for MVDC Shipboard Power System
Maziar Babaei, Ruhollah Jafari-Marandi, Sherif Abdelwahed, Brian Smith

A Novel Multi-Objective Security-Constrained Power Management for Isolated Microgrids in All-Electric Ships
Vahid Sarfi, Hanif Livani

Investigation and Performance Evaluation of Differential Protection of Phase-Shifted Transformers in an MV Drive
Zhen Ye, Jeff Fischer, Craig Goshaw, Benjamin Martin

Set-Based Design for Naval Shipboard Power Systems using Pertinent Metrics from Product Development Tools
T. Toshon, R.R. Soman, C.T. Wiegand, M. Israel, M.O. Faruque, M. Steurer

Reduced Order Multi-Rate LQR Controllers for a MVDC Shipboard Electric Distribution System with Constant Power Loads
Adam J. Mills, Robert W. Ashton
Stability of High-Bandwidth Power Electronic Systems with Transmission Lines
Jason Neely, Jarod Delhotal, Lee Rashkin, Steven Glover

Electrical Energy Storage for Dynamic Positiong Operations: Investigation of Three Application Case
M. Godjevac, K. Visser, E.J. Boonen, C. Malikouti, B.T.W. Mestemaker, Z. Lyu, F. van der Veen

Solid-State Fault Current Limiting for DC Distribution Protection
L. Qi, J. Pan, X. Huang, X. Feng

Energy Storage Management for MVDC Power System of All Electric Ship Under Different Load Conditions
Mohammed Masum Siraj Khan, M.O. Faruque

Ship to Shore Electric Interconnection: From Adolescence to Maturity

Optimal Sensor Placement for MVDC Ship Power System
Hesan Vahedi, Dallas Perkins, David Gonsoulin, Tuyen Vu, Chris S. Edrington

Seamless Inverter Control Scheme for Shore-to-Ship Application
Hesan Vahedi, David Gonsoulin, Dallas Perkins, Tuyen Vu, Chris S. Edrington

Power Density Comparison of Three-Phase AC Inductor Architectures
Veda Samhitha Duppalli, Scott Sudhoff

Early Stage Design Evaluation of Shipboard Power Systems using Multi-Period Power Flow
Eun Oh, Daniel F. Opila, John Stevens, Edwin Zivi, Aaron Cramer

Torque Enhancement and Re-Rating of Medium-Voltage Induction Machines using Nano-Structured Stator Winding Insulation
Yiqi Liu, Hiep Nguyen, Ali M. Bazzi, Yang Cao

Hybrid Energy Storage Module for Large-Scale Ship Pulsed Power
Stephen B. Kuznetsov

Power Converter Design Options for the 12 kVdc Bus System
A.L. Gattozzi, S.M. Strank, S.P. Pish, J.D. Herbst, R.E. Hebrn, F.D. Engelkemeir

Undersea Medium Voltage DC Power Distribution
Marcel P.J. Gaudreau, Neal Butler, Matthew Munderville

Reconfiguration of MVDC Shipboard Power Systems: A Model Predictive Control Approach
Nasibeh Zohrabi, Sherif Abdelwahed, Jian Shi

Novel Composite Structures for Smaller, Lighter Advanced Rotating Machines
Scott Pish, Jon Hahne, Joe Beno, Hamid Ouroua, Matt Tillman, Richard Hayes

The Cost of Model Accuracy in the Design of Wound Rotor Synchronous Machines for DC Generation
P.R. O'Regan, S.D. Pekarek
Robust Voltage Control in Large Multi-Converter MVDC Power Systems on Ships using Thyristor Interface Converters
Daniele Bosich, Andrea Vicenzutti, Giorgio Sulligoi

Nanostructured Insulation for High Torque Density Electric Propulsion Motors
Hiep Nguyen, Yiqi Liu, Weiqiang Chen, Mona Ghassemi, Jack Chapman, Ali Bazzi, Yang Cao

Modelling Methodology for Analysis of Shipboard Power Systems with Multiple Superconducting Devices
Sharath Satyanarayana, Sastry V. Pamidi, Lukas Graber, Jin-Geun Kim, Chul H. Kim

Multiphysics Model of a Notional All-Electric Ship Railgun – Model Development and Application
Sam Yang, Mauricio Chagas, Juan Ordonez, Jose Vargas

Practical Considerations for the Design of a Superconducting Gas-Insulated Transmission Line for Shipboard Applications
Peter Cheetham, Chul H. Kim, Lukas Graber, Sastry Pamidi

Analyzing the Effectiveness of dI/dt and Current Differential Fault Detection Methods in Zonal MVDC Shipboard Power Systems
Harsha Ravindra, Mark Stanovich, Tony Challita, Michael - Mischa Steurer

1000V Lithium Ion Battery Module with Novel Measurement and Protection Technologies
David A. Dodson, David Wetz, John Heinzel, Steve Cummings, Nick Frank, Aida Rahim, Matthew Davis

Dielectric Breakdown of Vented Li-Ion Battery Electrolyte
Charles Nybeck, David Wetz, David A. Dodson, John Heinzel

Wednesday, August 16

7:00 am    Breakfast (Jefferson 1/2)

8:00 am    Keynote Address (Jefferson 1/2)

8:30 am    B1L-P (Jefferson 1/2)
Electrification at Sea
Chair: John Amy, NSWC Philadelphia
Commander Malcolm Tonge, CEng FIMarEST Royal Navy
Perry Haymon, HII, Director Surface Warfare

10:10 am   Coffee Break
10:30 am  B1L-A (Jefferson 3)
Electric Ship Design Tools for Real Time Simulation  
Chair: Norbert Doerry, Naval Sea Systems Command (SEA 05TD)

Hardware-in-the-Loop Testing of High Switching Frequency  
Power Electronics Converters  
Michele Difronzo, Matthew Milton, Matthew Davidson, Andrea Benigni

Power Hardware-in-the-Loop Simulation Testing of a Flywheel Energy  
Storage System for Shipboard Applications  
James Langston, Michael Steurer, Karl Schoder, Joseph Borraccini,  
Don Dalessandro, Tim Rumney, Tom Fikse

Advances to Megawatt Scale Demonstrations of High Speed  
Fault Clearing and Power Restoration in Breakerless  
MVDC Shipboard Power Systems  
Dionne Soto, Mike Sloderbeck, Harsha Ravindra, Mischa Steurer

MIMO Identification Techniques in Online Measurement of Bus  
Impedance of Interconnected Power-Electronics Systems  
Tomi Roinila, Hessamaldin Abdollahi, Silvia Arrua, Enrico Santi

Computation of Time-Domain Impulse-Response from Band-Limited  
Ship Power Distribution Models using Wavelet Transformation  
Maryam Rahmani, Michael Mazzola, Shantia Yarahmadian

10:30 am  B1L-B (Crystal 5/6)
Energy Storage and Pulsating Loads II  
Chair: Giorgia Sulligoi, University of Trieste

Predictive Energy Management for MVDC All-Electric Ships  
Tuyen V. Vu, David Gonsoulin, Dallas Perkins, Fernand Diaz,  
Hesan Vahedi, Chris S. Edrington

Distributed Independent Controls for Managing Short  
Circuit Faults in MVDC Power Systems  
Qiu Deng, Roger A. Dougal

Enhancing the Robustness of Shipboard DC Hybrid Power System  
against Generator Failures  
Kexing Lai, Mahesh S. Illindala

Distributed Energy Storage Allocation Algorithm for  
Early Stage Design  
James Langston, Mark Stanovich, Karl Schoder, Michael Steurer

Experimental Test Bed to De-Risk the Navy  
Advanced Development Model  
S. Strank, X. Feng, A. Gattozzi, D. Wardell, S. Pish, J. Herbst, R. Hebner

12:15 pm  Lunch
1:30 pm  B2L-A (Jefferson 3)
Power System Control Methods and Architectures I
*Chair: Fletcher Fleming, DRS Technologies*

**Grounding and Fault Location in Power Electronic based MVDC Shipboard Power and Energy Systems**
Ben Ford, Isaac Leonard, Matt Bosworth, Mischa Steurer

**Model Validation of Multi-Pulse Rectifiers for Charging Capacitors**
Brian J. McRee, David A. Wetz, David A. Dodson, John M. Heinzl, Qing Dong

**Market-Based Control of Electric Ship Power Systems**
YuQi Zhang, Aaron M. Cramer

**Ensuring Stability in a Multi-Zone MVDC Shipboard Power System**
Seth Cooper, Hashem Nehrir

**Evaluation Framework for Power and Energy Management Shipboard Distribution Controls**
Karl Schoder, Mark Stanovich, Tuyen Vu, Hesan Yahedi, Chris Edrington, Michael Steurer, Herb Ginn, Andrea Benigni, Chika Nwankpa, Karen Miu, Frank Ferrese

1:35 pm  B2L-B (Crystal 5/6)
Advances in Circuit Protection Technology
*Chair: Andrea Benigni, University of South Carolina*

**Insulation Design and Evaluation via Partial Discharge (PD) Test for Power Electronics Application**
Yue Xu, Rolando Burgos, Dushan Boroyevich

**H-Type DC Breaker Tests to Moderate Power**
Chathan Cooke, James Gafford, Michael Mazzola, Chryssostomos Chryssostomidis

**Solid State Circuit Breakers for Shipboard Distribution Systems**
Rostan Rodrigues, Taosha Jiang, Yu Du, Pietro Cairoli, Huaxi Zheng

**Solid-State Breaker Protection in MVDC Systems**
Keith Corzine, Allan Overstreet, Tom Baragona

**High Speed Disconnect Switch with Piezoelectric Actuator for Medium Voltage Direct Current Grids**
M. Bosworth, D. Soto, R. Agarwal, M. Steurer, T. Damle, L. Graber

3:15 pm  Coffee Break

3:30 pm  B3L-A (Jefferson 3)
Electric Propulsion and Generation
*Chair: Dwight Alexander, Northrop Grumman*

**Optimum Design of a Lightweight 10MW Propulsion Motor**
Russel H. Marvin, Dylan J. Broomfield, Brian T. Helenbrook, Kenneth D. Visser
Interleaving Angle Variation Analysis for Variable Frequency PWM Drives
Robert W. Ashton, Michael C. Knauff, Chris J. Dafis

A Comparison of Permanent Magnet Machine Topologies for Marine Propulsion Applications
Andrew Kasha, Ruiyang Lin, Scott Sudhoff, Julie Chalfant, Jamal Alsawalhi

Alternating Flux Barrier Design of Vernier Ferrite Magnet Machine having High Torque Density
Wenbo Liu, Thomas A. Lipo

A Quantitative Comparison of Hybrid Diesel-Electric and Gas-Turbine-Electric Propulsion for Future Frigates
Rinze Geertsma, Jasper Vollbrandt, Rudy Negenborn, Klaas Visser, Hans Hopman

Magnetic Equivalent Circuit-Based Simulation of a 6-Phase Generation System
D.C. Horvath, S.D. Pekarek, T.E. Craddock

3:30 pm  B3L-B (Crystal 5/6)
Electric Ship Design Tools for Early-State Ship Design II
Chair: Norbert Doerry, Naval Sea Systems Command (SEA 05TD)

Investigation of Product Development Tools to Aid Naval Shipboard Power Systems Design
R.R. Soman, C.T. Wiegand, T.A. Toshon, M.O. Faruque, M. Steurer

Graph Theory Applications in FOCUS-Compliant Ship Designs
Julie Chalfant, Chrys Chryssostomidis, Daniel Snyder, Mark A. Parsons, Alan Brown

Early-Stage Design of Shipboard Integrated Power Systems: CSI-Based Multiple Solutions Comparison

All-Electric Warship Load Demand Model for Power and Energy System Analysis using Exogenously Initiated Threats
John D. Stevens, Daniel F. Opila, Eun S. Oh, Edwin L. Zivi

Dynamic Considerations of Power System Coupling through Dual-Wound Generators
L.J. Rashkin, J.C. Neely, S.F. Glover, T.J. McCoy, S.D. Pekarek

System-Level Ship Thermal Management Tool for Dynamic Thermal and Piping Network Analyses in Early-Design Stages
Sam Yang, Juan Ordonez, Jose Vargas, Julie Chalfant, Chryssostomos Chryssostomidis

5:10 pm  Break

6:40 pm  Dinner (Jefferson 1/2)
Thursday, August 17

7:15 am  Breakfast (Jefferson 1/2)

8:00 am  C1L-A (Jefferson 3)
Electric Ship Design Tools for Discipline Specific Studies
Chair: Terry Ericsen, Ericsen Innovations, LLC

Investigation of Drivetrain Losses of a DP Vessel
Torstein I. Bø, Anna Swider, Eilif Pedersen

Real-Time Implementation of MVDC Shipboard
Power System Reconfiguration
Maziar Babaei, Ruhollah Jafari-Marandi, Sherif Abdelwahed

Algorithm-Based Evaluation of Ramp Rate and Pulsed
Power Loading for AC Electric Systems
Marie A. Lawson, Mohamed Belkhayat, Kyle L. Maynard,
Doug Mintz, Jason M. Johnson

A Performance Evaluation Approach for Power Electronic
CHIL Simulation Methods using Multiple Real-Time
Modeling and Simulation Algorithms
Karl Schoder, Isaac Leonard, Fernand Diaz, M. Omar Faruque,
Michael Mischa Steurer, Tuyen Vu, Mike Sloderbeck, Christopher Edrington

8:00 am  C1L-B (Crystal 5/6)
Power System Control Methods and Architectures II
Chair: Christopher Edrington, Florida State University

Distributed Power Management for DC Distribution System with
Model Uncertainties
Dallas Perkins, Tuyen Vu, Hesan Vahedi, David Gonsoulin, Chris S. Edrington

Distributed Control Implementation for Zonal MVDC
Ship Power Systems
Tuyen V. Vu, David Gonsoulin, Dallas Perkins, Behnaz Papari,
Hesan Vahedi, Chris S. Edrington

Control System Communication Architecture for
Power Electronic Building Blocks
Ivan Panchenko, Jason D. Bakos, Herbert L. Ginn III

Coordinating Multiple Energy Storages using MPC for
Ship Power Systems
David E. Gonsoulin, Tuyen V. Vu, Fernand Diaz, Hesan Vahedi,
Dallas Perkins, Chris S. Edrington
High-Fidelity Modeling and Optimization of Conjugate
Heat Transfer in Arrays of Heated Cables
Zhicheng Wang, George Em Karniadakis, Julie Chalfant,
Chryssostomos Chryssostomidis, Hessam Babaee

A Predictive Engine for On-Line Optimal Microgrid Control
Joseph Young, Marvin A. Cook, David G. Wilson

10:20 am C2L-A (Jefferson 3)
Energy Storage and Pulsating Loads II
Chair: Giorgia Sulligoi, University of Trieste

Efficiency Optimization and Autonomous Converter Support
via a Modular Resonance Unit
Christopher Scioscia, Brandon Grainger

Integration and Study of Hardware in the Loop Diesel Generator with
a Hybrid Energy Storage Module for Naval Applications
Jacob Sanchez, David Wetz, Qing Dong, John Heinzel

Current Sharing in Parallel Cell Batteries Cycled at High C Rates
C.S. Westenhover, D.A. Wetz, M.J. Martin, C.G. Gnegy-Davidson,
D.A. Dodson, John Heinzel

Electrical and Thermal System Considerations for MVDC
Superconducting Distribution on Navy Ships
R.E. Hebner, A.L. Gattozzi, S.M. Strank, S.P. Pish, J.D. Herbst

Next-Generation MVDC Architecture based on 6.5 kV / 200 A, 12.5
mΩ SiC H-Bridge and 10 kV / 240 A, 20 mΩ SiC Dual Power Modules
Ajit H. Wijenayake, Ty McNutt, Kraig J. Olejniczak, Brandon Passmore,
Alex Lostetter, Jonathan Hayes, Yusi Liu, H. Alan Mantooth

10:20 am C2L-B (Crystal 5/6)
SiC Device based Optimal Design for Power Conversion
Chair: Harish Suryanarayana, ABB Inc

Optimal Sizing of Modular Multi-Level Converters Designed for
Shipboard Applications
Marzieh Karami, Robert M. Cuzner

Power Electronics Building Block (PEBB) Design based on
1.7 kV SiC MOSFET Modules
Jun Wang, Zhiyu Shen, Igor Cvetkovic, Niloofar R. Mehrabadi, Alinaghi Marzoughi,
Sungjae Ohn, Jianghui Yu, Yue Xu, Rolando Burgos, Dushan Boroyevich

Optimization of a Wide Bandgap based Generation System
Bo Zhang, Scott Sudhoff, Steven Pekarek, Jason Neely

A High-Power-Density, High-Speed Gate Driver for a
10 kV SiC MOSFET Module
C. Dimarino, J. Wang, R. Burgos, D. Boroyevich
Computationally Efficient Leakage Inductance Calculation for a High-Frequency Core-Type Transformer

Veda Samhitha Duppalli, Scott Sudhoff

12:00 pm  End Symposium