Good Afternoon,
You are invited to attend our weekly ECE Graduate Seminar.

Old Dominion University
College of Engineering and Technology
Department of Electrical and Computer Engineering

All lectures to be held at 3:00pm on Fridays online at ODU DL: ECE 731 831 Grad Seminar

For more information, contact Dr. Chung Hao Chen at (757) 683-3475 or email cxchen@odu.edu.

Friday, November 19, 2021 Seminar Topic:
PROTECTION AND DISTURBANCE MITIGATION OF NEXT GENERATION SHIPBOARD MVDC POWER DISTRIBUTION SYSTEMS by Marounfa Djibo, Ph.D. Candidate in the Department of Electrical & Computer Engineering at Old Dominion University

Abstract:

Today, thanks to modern advances mainly in the power electronics field, many new megawatt-level technologies such as electric drives for ship propulsion, magnetic levitation, advanced combat systems are being integrated into the marine power grids. These technologies operate based on DC power, which require AC to DC conversion within the current grid. Medium-voltage Direct Current (MVDC) is the next state-of-the-art technology that researchers are leaning on to produce, and distribute power with improved power quality, reliability, and flexibility. On the other hand, with the extensive integration of high-frequency power electronic converters, system stability analysis and the true system dynamic behaviors assessment following grid disturbances have become a serious concern for system control designs and grid protection.

This work first explores emerging MVDC shipboard power distribution topology now being considered for enabling new capabilities for future warfighters. Furthermore, the important topic of how these systems perform in dynamic conditions with pulsed power loads (PPLs), faults, as well as designing robust electrical system protection are studied. A communication-based fault detection and isolation system controller that improves upon a directional ac overcurrent relay protection system is proposed offering additional protection discrimination between faults and PPLs in MVDC systems. The controller is designed to distinguish between system dynamic short-circuit faults and bus current disturbances due to a future PPLs in naval vessels.

Finally, to validate the effectiveness of the proposed protection controller, different bus current disturbances are simulated within a time-domain electromagnetic transient simulation of a shipboard power system including a PPL system operating with different ramp rate profiles, pulse widths, peak powers, and fault locations. This overarching goal of this work is to address some of the critical issues facing the US Navy as warfighter mission requirements increase exponentially and moves towards advanced and sophisticated PPL devices such as high-energy weapon systems, high-energy sensor and radar systems. The analyses and proposed solutions in this work support current shipbuilding industry priorities to improve shipboard power system reliability and de-risk the integration of new power system technologies for next generation naval vessels.

Bio:
Marounfa Djibo is a Ph.D. candidate in in the Department of Electrical & Computer Engineering at Old Dominion University. He received the Bachelor's and Master's degree in Electrical and Computer Engineering from the University of South Alabama, Mobile, Alabama USA in 2010 and 2013 respectively. Since 2012, he has been working at Huntington Ingalls industries as nuclear system test engineer. He successfully passed his Ph.D. defense in September 2021 for Ph.D. degree in Electrical and Computer Engineering at Old Dominion University, Norfolk, Virginia USA. His interests are dynamic modeling and testing of marine power, protection, and pulsed power systems.