

Bridging the Gap: EMT Training and Education for Modern Engineers

Maryam Saeedifard

Professor, School of Electrical and
Computer Engineering

Georgia Institute of Technology

ORNL is managed by UT-Battelle, LLC for the US Department of Energy

Introduction: EMT Modelling Applications (Personal Experience)

- Fast transients leading to trips, disconnections, momentary cessations – fault studies
- Subsynchronous and harmonic resonances and stability issues
- Stability issues of Multi-Terminal HVDC grids meshed inside the legacy AC grid
- Black start studies
- Grid integration of offshore wind farms and PV farms
- Grid forming and grid following inverters
- Future control functionalities in PV-ESS farms
- Stability issues in HVDC-connected offshore wind farms
- Design and test of utility-scaled power electronic converters

Introduction: The Need for Detailed Whole-System EMT Studies with High Penetration of IBRs

- Changing power system landscape with ever increasing Inverter-Based Resources (IBRs), mixed generation (GFM and GFL converters) and increased complexity
- Account for interactions among stability, power quality and protection
- Optimized solutions with a wholistic approach for accurate analysis

Current Status of Trainees

- **Limited Exposure to EMT Tools**

- B.Sc. students have very limited exposure during their coursework
- M.Sc. and Ph.D. students primarily engage during coursework projects and/or research.

- **Tools Used:** PSCAD/EMTDC software package

- **Exposure to Advanced Simulation Tools**

- Real-time simulation and/or hardware-in-the-loop simulation are primarily used for research purpose, with limited exposure for other students.

Current Workforce & Challenges

- Workforce Status
 - Growing demand for skilled professionals in EMT studies because of transformation in power system landscape and decarbonization goals
 - Increasing need for specialized training and education
 - Collaboration between academia, industry, and research institutions

Current Workforce & Challenges (Cont'ed)

- Challenges

Skill Gap: Limited number of professionals with expertise in EMT simulation tools

Complexity: High complexity of EMT studies requiring advanced knowledge and experience

Technology Integration: Challenges in integrating EMT tools with other engineering software and systems

Keeping Up-to-Date: Rapid advancements in technology requiring continuous learning and adaptation

Resource Constraints: Limited access to high-performance computing resources for detailed simulations

Approach: EMT Training/Education

- **Theoretical Foundations:** Understanding the principles of electromagnetic transients and their impact on power systems studies.
- **Hands-On Practice:** Utilizing EMT simulation tools to model and analyze real-world scenarios.
- **Case Studies:** Examining detailed case studies to learn from practical examples and industry experiences.
- **Continuous Learning:** Staying updated with the latest advancements and trends in EMT simulation technologies.

Approach: EMT Training/Education (Cont'ed)

- **Step-by-Step Tutorials:** Guiding trainees through the use of EMT tools and their features.
- **Interactive Workshops/Tutorials:** Engaging participants in practical exercises and collaborative projects by including industry-experts.
- **Revamping Undergraduate/Graduate Education:** Offline and online teaching/learning

Approach: Re-Training Workforce

- **Leverage Online Learning Platforms**

- **E-Learning Modules:** Develop or use existing online courses that employees can take at their own pace.
- **Webinars & Virtual Labs:** Conduct live webinars with experts and provide access to virtual labs where employees can practice simulations.
- **Expert Mentors:** Pair trainees with experienced mentors who can provide guidance and answer questions.

- **Practical Hands-On Workshops**

- **Interactive Workshops:** Conduct workshops where trainees can apply what they've learned in a controlled environment.
- **Simulation Projects:** Assign real-world projects where trainees must use EMT tools to solve problems or optimize systems.
- **Case Studies:** Review and analyze case studies that illustrate successful applications of EMT simulations in the industry.

Gaps & Challenges: EMT Training/Education

- **Limited Access to Tools:**
 - Many institutions and professionals lack access to advanced EMT simulation tools due to high costs.
- **Insufficient Curriculum Coverage:**
 - EMT topics are often underrepresented in engineering curricula.
 - Lack of standardized EMT educational materials and textbooks.
- **Shortage of Skilled Instructors:**
 - Few educators have the specialized knowledge and experience required to teach EMT effectively.
- **Inadequate Practical Training:**
 - Limited hands-on practice opportunities for students and professionals.
 - Need for more real-world case studies and practical examples.
- **Lack of Industry-Academia Collaboration:**
 - Insufficient partnerships between educational institutions and industry for curriculum development and practical training.

Next Steps: EMT Training/Education

- **Develop a Comprehensive Curriculum:** Collaborate with academia, industry experts, and professional organizations to include both theoretical knowledge and practical applications.
- **Expand Access to EMT Tools:** Provide access to cutting-edge EMT simulation tools for students and professionals.
- **Enhance Training Programs:** Design and implement detailed training programs with step-by-step tutorials. Conduct workshops, seminars, and webinars with hands-on practice.
- **Foster Industry-Academia Collaboration:** Facilitate partnerships between universities and industry for research and training.
- **Interface to Other Tools:** Facilitate interfacing EMT offline and online simulation tools and HIL

Next Steps: Re-train Existing Workforce

- **Develop Affordable Training Programs:** Create cost-effective training programs using accessible EMT tools and simulation software.
- **Enhance Curriculum with EMT Focus:** Develop and distribute standardized educational materials and textbooks focused on EMT.
- **Expand Practical Training Opportunities:** Provide workshops with hands-on practice sessions using simulations tools and incorporate real-time case studies.

Q&A