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# REAL-TIME SIMULATION FOR POWER SYSTEMS: APPLICATIONS, CHALLENGES, AND FUTURE DIRECTIONS


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The use of real-time simulation systems has become widespread in both research and industry for a multitude of applications. By connecting real-time simulators with physical components, real systems and devices can be tested under diverse operating conditions. This significantly accelerates the development of new devices and control systems while reducing the time between conception, implementation, and market deployment.

Real-time simulation is now a well-established tool in power systems. Through various applications, such as Hardware in-the-Loop (HIL), Power Hardware-in-the-Loop (PHIL), and Controller Hardware-in-the-Loop (CHIL) testing, it enables in-depth studies of new mathematical models for energy resources and electrical networks. It also allows for testing real devices under extreme grid conditions (such as short circuits and voltage sags), analyzing electrical components' behavior under grid frequency variations or high harmonic levels, and validating monitoring and control systems for small, medium, or large-scale power grids.

Despite its increasing adoption, real-time simulation remains a complex topic with many challenges to address. As models of electrical components and control systems become more complex, more attention must be paid to computational efficiency, measurement accuracy, and synchronization and stability of connections between hardware and software devices. To meet the stringent requirements of real-time simulation, decoupling approaches and multi site co-simulation techniques have been explored in the literature, paving the way for collaboration among research teams and between academia and industry.

Given its broad range of applications and its relevance to both scientific research and industrial practice, this special session is expected to attract a diverse group of authors and researchers. By gathering practical case studies and emerging solutions, the session provides a unique opportunity for participants to share their work and explore new collaborations for research projects and future innovations.

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