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Controlling complex resources over different timeframes in process control

Professor Penelope Sanderson
Dr Rizah Memisevic[1]
Cognitive Engineering Research Group
The University of Queensland

Monitoring and controlling complex systems becomes particularly challenging when human controllers must satisfy constraints operating in multiple timeframes. Examples of systems with such temporal complexity are air traffic control, chemical process control, and power generation. We outline how the problem of temporal complexity emerges in different domains and imposes challenges to effective control. To illustrate our work we focus on hydropower system control. A hydropower company generates power according to targets handed down by the central market organisation and responds to market opportunities, but at the same time must preserve the ability to meet corporate strategic and tactical objectives. The human controller at the "sharp end" of hydropower system operations must coordinate water, generation, and transmission resources consistently with those objectives. In this presentation we describe the information needed by hydropower system controllers for effective control. Specifically, we outline the general form of analyses that identify the purposes, priorities and functions of the hydropower domain, and that identify the timeframes in which different subsystems function. From such analyses we develop the general form of interface displays that help human controllers solve the problem of coordinating resources over different timeframes. In particular, such displays make the temporal boundaries of safe operating regions visible. Finally, we draw conclusions for analysis and design of human-system interfaces for complex systems in which resources must be coordinated by different parties across multiple timeframes.

[1]Now at Powerlink Queensland P/L