A Review of Digital Twin Technology and an Approach for a Robust Digital Twin for Power Systems Applications

Jeremy Till¹, Clifton Black², Yilu Liu¹,³

¹ The University of Tennessee, Knoxville  ² Southern Company  ³ Oak Ridge National Laboratory

MOTIVATION

- Digital twins are popular in other industries
- Digital twins are a novel way to utilize advanced technology
- Current literature for applications in power systems is very limited
- New capabilities may prove beneficial contextualized with issues relating to renewables and other emerging technology

CONCLUSION

- Digital twins are viable in power system applications
- Digital twins enable much greater real-time analysis of power systems
- New technologies will increase the need for real-time analysis
- A robust digital twin platform can take advantage of high-fidelity simulations for a wide variety of applications

DIGITAL TWIN DEFINITION

A digital twin is:
1. A digital model of a physical system, that
2. can receive data from the physical system and
3. create output that supports the operation of the physical system,
4. in real-time.

EXISTING POWER SYSTEM DIGITAL TWINS APPLICATIONS

Scale is a limiting factor for power system digital twins. Real-time simulation is computationally intensive. As a result, existing digital twins primarily cover singular components or small microgrid applications. Transmission and distribution are mainly theory. To the right are existing or theorized applications in current literature.

PROPOSED ROBUST APPROACH TO DIGITAL TWINS

- Digital twins are usually defined in three layers
  - Physical
  - Cyber
  - Application
- The digital twin mirrors the physical twin (i.e. the physical grid)
  - Physical – Electromechanical
  - Cyber – Communications and control
- The application layer is dependent on desired scope
- Possible flow from application layer to physical twin includes (but is not limited to):
  - Automatic control of the physical grid
  - Automatic output for grid operators