















control with minimum energy.

We developed an EnergyPlus-Python bridge, called pyEp, to interface Python code with EnergyPlus to perform co-simulations, which is useful for implementing advanced algorithms such as machine-learning-based modeling and optimization-based control. We also developed an EnergyPlus-OPC bridge, which completes our toolchain for integrating E+ and D+ models into SCADA systems. Through OPC tag mappings, these digital twins can directly exchange data with a SCADA system, receiving control commands and returning measurement values as if they were real buildings. For the first time, our toolchain has enabled seamless real-time in-the-loop prediction and advanced control of both software buildings and physical buildings within the same SCADA environment. The toolchain was demonstrated in a case study, which showed the effectiveness of both our software and our proposed data-driven MPC approach for buildings.

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