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A Comparison of Model Reduction Approaches for Feedback Control Design of Thermal Flows in Buildings JEFF BORGGAARD, Virginia Tech, SUNIL AHUJA, United Technologies Research Center, JOHN BURNS, EUGENE CLIFF, Virginia Tech, AMIT SURANA, United Technologies Research Center — The application of distributed parameter control to spatiotemporal thermofluid systems requires the use of model reduction methods. The form of the optimal feedback control can inform design decisions, such as sensor and actuator selection and placement. A number of model reduction approaches for fluid systems have been put forward that are based on the proper orthogonal decomposition (POD). In this talk, we examine three approaches, the traditional POD-Galerkin model, the POD-Sensitivity model, and the Balanced-POD models. Our work is motivated by the building indoor environment control problem. Energy performance in building cooling and heating systems can be substantially improved by exploiting spatial temperature stratification and buoyancy that are prevalent in passive systems. We consider the control of airflow in a room with a passively cooled radiant ceiling and displacement ventilation provided near the room floor. For this problem, we approximate the full-order solution to compute the control gains, develop reduced-order models and associated controllers, and simulate the full-order closed-loop system for comparison with the reduced-order model-based control design.

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