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Controlling Hazardous Releases while Protecting Passengers in Civil Infrastructure Systems[1] SARA P. RIMER, NIKOLAOS D. KATOPODES, University of Michigan - Ann Arbor — The threat of accidental or deliberate toxic chemicals released into public spaces is a significant concern to public safety, and the real-time detection and mitigation of such hazardous contaminants has the potential to minimize harm and save lives. Furthermore, the safe evacuation of occupants during such a catastrophe is of utmost importance. This research develops a comprehensive means to address such scenarios, through both the sensing and control of contaminants, and the modeling of and potential communication to occupants as they evacuate. A computational fluid dynamics model is developed of a simplified public space characterized by a long conduit (e.g. airport terminal) with unidirectional ambient flow that is capable of detecting and mitigating the hazardous contaminant (via boundary ports) over several time horizons using model predictive control optimization. Additionally, a physical prototype is built to test the real-time feasibility of this computational flow control model. The prototype is a blower wind-tunnel with an elongated test section with the capability of sensing (via digital camera) an injected 'contaminant' (propylene glycol smoke), and then mitigating that contaminant using actuators (compressed air operated vacuum nozzles) which are operated by a set of pressure regulators and a programmable controller. Finally, an agent-based model is developed to simulate "agents" (i.e. building occupants) as they evacuate a public space, and is coupled with the computational flow control model such that agents must interact with a dynamic, threatening environment.

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