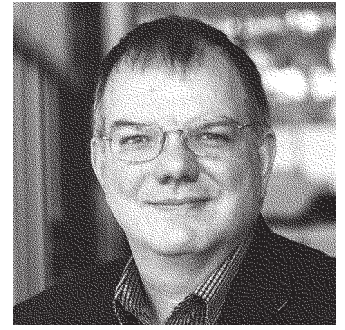# MINI-KEYNOTE: THE DRIVERLESS CITY PROJECT

Abstract

Ubiquitous co-robots offer society a unique opportunity to reshape our transportation infrastructure. To do so, we must balance the needs of safety, usability, and aesthetics. This research will investigate these tradeoffs in an effort to understand how to turn twentieth century transportation infrastructure (e.g. highways, intersections, roads, sidewalks) into twenty-first century human infrastructure that addresses the needs of the entire community. There is a clear link between a robot's ability to localize within an environment and that environment's physical structure. Tall buildings can severely compromise GNSS1 signals; landmarks that are spaced too far apart decrease localization accuracy; and the same landmarks spaced too close together can introduce a higher probability of faulty measurement associations. There is also a clear link between a robot's ability to localize itself and safety—robots that cannot guarantee that their pose lies within a given covariance envelope are safety risks to nearby humans and objects. This safety risk may be small enough such that one or two mobile robots operating among humans would rarely cause harm. However, as we approach the concept of "ubiquitous co-robots," the probability of unsafe operation increases by orders of magnitude that, if left unaddressed, could be life-threatening and erode the public's trust in co-robot technology.

To mitigate safety risk, one could shape the environment to maximize a robot's localization safety, similar to the careful placement of radio-navigation equipment at airports for approaching aircraft. This could be done by creating ordinances that dictate the appearance of the streetscape so that self-driving cars, drones, and other mobile co-robots can guarantee their pose covariance envelope in the presence of faults as they navigate. However, modifying the environment to maximize co-robot safety could have negative and wide-ranging societal impacts if the process does not consider the needs of other stakeholders, such as pedestrians, cyclists, drivers, vehicle passengers, homeowners, business owners, robot manufacturers, and the government.

In response, a highly interdisciplinary research project led by Professor Matthew Spenko (Director, IIT Robotics Lab), Boris Pervan (Director, IIT Navigation Lab), and Ron Henderson (Director, IIT Landscape Architecture + Urbanism Program) have received National Science Foundation funding to study the relationship between landscape architecture, city planning, and mobile co-robot navigation safety and the impact that ubiquitous robots will have on shaping urban design. The findings of this research, currently entering its third year, will be a framework that will inform city planners, architects, and landscape architects how to plan and design cities in which ubiquitous robots safely interact with humans and also educate roboticists on how the technology they are developing impacts other aspects of society.

Author

Ron Henderson
Illinois Institute of Technology

Professor Ron Henderson is an international leader in landscape architecture design, history, research, and education. His broad range of current research includes: The Driverless City Project, gardens and contemporary urbanism in China and Japan, arboriculture and horticulture practices, botanical drawing, and landscape-based urbanism. He is the author of "The Gardens of Suzhou" and numerous articles on landscape architecture and urbanism. His next publication, "The Driverless City," focuses on the urban design implications of driverless and autonomous vehicles.

Professor Henderson is invited to lecture frequently, with recent talks at Harvard University, Tongji University, Beijing Forestry University, Oslo AHO, ETSAB Barcelona, Chiba University, Boston University, DESIGNxRI, U.S. National Arboretum, Dumbarton Oaks, and the Graham Foundation, among others. He has held previous appointments at Harvard, Pennsylvania State University, Tsinghua University, and Rhode Island School of Design. He is a Senior Fellow of Garden and Landscape Studies at Dumbarton Oaks and a fellow of the American Society of Landscape Architects.