



IRIM Seminar Series

Ballbots

Ralph L. Hollis | Professor Emeritus; Carnegie Mellon University

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Abstract: Who would want to make a mobile robot that has only a single spherical wheel? Well, I did! My talk will trace the development of the first successful “ballbot,” beginning in 2004. Now, many ballbots have been built or studied by other groups around the world—nearly 200 technical papers have been published with “ballbot” (a term I coined) in the title or abstract. Basic principles of the ballbot will be briefly described, including several experimental forays exploring its utility in everyday human environments. We introduce balancing, station keeping, and navigation from place to place within a map using LIDAR or visual simultaneous localization and mapping (SLAM). The addition of arms to the ballbot body adds complication, but also increases the range of possible applications. For example, large payloads can be lifted and transported when the ballbot leans its body. I will briefly summarize our current whole-body planning and control efforts.

In a quest to simplify the ballbot’s mechanics, we invented a novel closed-loop spherical motor (SIM) that is controllable in torque, velocity, and position in arbitrary directions. The SIM was used to create “SIMbot,” a functioning mobile robot that has only a body and a ball.

Finally, I will introduce a new, smaller, cheaper ballbot, which we call “Shmoobot,” that we are working to replicate for use as a platform for research and education in motion planning, control, and human-robot interaction.

Bio: Ralph Hollis received the B.S. and M.S. degrees in physics from Kansas State University, Manhattan, in 1964 and 1965, and the Ph.D. degree in solid state physics from the University of Colorado, Boulder, in 1975. From 1965 to 1970, he was engaged in computer simulation of space-flight vehicles at the Autonetics Division of North American Aviation. He was a National Science Foundation / Centre Nationale de la Recherche Scientifique Exchange Scientist at the Universite de Pierre et Marie Curie, Paris, for part of 1976-77. He joined IBM in 1978 at the Thomas J. Watson Research Center as a Research Staff Member, where he worked in magnetism, acoustics, and robotics. From 1986 to 1993, he was Manager of Advanced Robotics in the Manufacturing Research Department. Dr. Hollis joined the faculty at Carnegie Mellon University in 1993 where he is a Professor Emeritus in the Robotics Institute, School of Computer Science. Dr. Hollis is a member of the American Physical Society and a Life Fellow of IEEE. He has served on several government panels and editorial boards. At IBM, he received five Invention Achievement Awards and an Outstanding Technical Achievement Award for work in precision robotic positioning. He is founding director of the Microdynamic Systems Laboratory at CMU where he and his team have pursued research in agent-based microassembly, magnetic levitation haptics, and dynamically stable mobile robots. He is president of Butterfly Haptics, LLC.



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