

## Public Abstract

First Name:Samuel

Middle Name:Neal

Last Name:Blisard

Adviser's First Name:Marjorie

Adviser's Last Name:Skubic

Co-Adviser's First Name:

Co-Adviser's Last Name:

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It has long been a dream of science fiction to have a robot that can understand and communicate using the rich dialog of natural language. Having such capabilities would allow a human collaborator to interact naturally and efficiently with the robot. In this work, I investigate the use of 3D Spatial Referencing Language (SRL) using the Histogram of Forces (HoF) to facilitate better interactions between users and robots or other intelligent systems. SRL in this work is natural language that people use to describe their surrounding environment and includes spatial-relational prepositions such as left, behind, on top of, inside and near. I also compare the HoF spatial referencing tool to Regier and Carlson's Attention Vector Sum (AVS)[1] and show that the HoF models human spatial behavior without the limitations of the AVS. A second investigation develops the 3D spatial relationships "NEAR, INSIDE, ON TOP OF, and UNDERNEATH" using data from a stereo vision system. A final set of investigations and experiments involve the creation of an architectural description language to create 3D models of real buildings, qualitative and quantitative metrics for evaluation, and a walkthrough using a virtual agent to describe the interiors of the constructed 3D model.