

MuSoHu: Multi-Modal Social Human Navigation Dataset

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Project Website: <https://cs.gmu.edu/~xiao/Research/MuSoHu/>



Fig. 1: MuSoHU Data Collection in Public Spaces

A popular avenue toward socially compliant robot navigation [1]–[3] is using Machine Learning (ML) [4]–[8] for robots to learn the variety of unwritten social norms, which are hard to capture with traditional cost functions [9]. However, most ML approaches require an extensive amount of training data, which is difficult to acquire in the real world. Considering the goal of creating socially compliant robot navigation and the availability of many humans that excel at such a task, this work leverages the easily accessible social human navigation data in public spaces for mobile robots to learn from.

We design and make publicly available¹ a wearable data collection device that provides common multi-modal perceptual streams on mobile robot platforms. Our device is equipped with a 3D LiDAR, a built-in IMU Stereo & Depth camera, a microphone array, and a 360° camera. All the sensors are mounted to a helmet via open-sourced hardware to capture egocentric data during social navigation (Fig. 1).

We collect an initial Multi-modal Social Human navigation dataset (MuSoHu) with ~ 50 km, 10 hours, 150 trials on the George Mason University campus and in the Washington DC metropolitan area. We are also continuing our data collection effort with the goal of acquiring > 100 km human social navigation data.

Data Collection Procedure: To collect MuSoHu, 7 human demonstrators wear the sensor suite helmet and navigate to predefined goals in public spaces in a socially compliant manner. Notably, in many cases, we record three trials of the same trajectory to capture three navigation contexts, i.e., *casual*, *neutral*, and *rush*, in which walking speed and safety distance from others may vary, in order to encourage

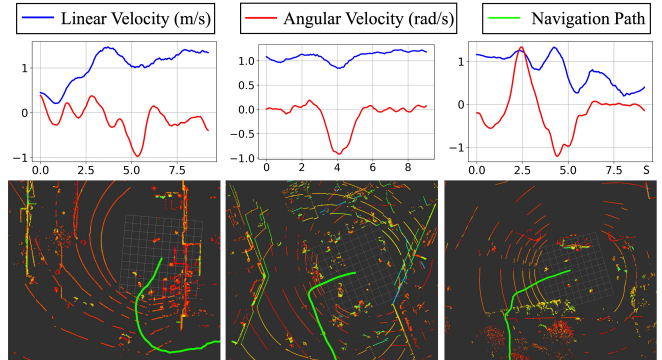


Fig. 2: Linear (Blue) and Angular (Red) Velocities and Navigation Path (Green) Taken by the Human Demonstrator.



Fig. 3: Learned Obstacle Avoidance Behavior from MuSoHu.

different social navigation interactions based on different contexts.

Dataset Analyses: MuSoHu includes a list of textual tags for each trajectory that describe the different social interactions that occur along the path. We expand beyond the tags from a similar Socially Compliant Navigation Dataset, SCAND [10], and the full list of 17 predefined labels can be found in our paper [11]. In Fig. 2, we show the corresponding linear and angular velocities and navigation path taken by the human demonstrator in three different scenarios. We use a small subset of MuSoHu data to train two Behavior Cloning policies that map from either raw LiDAR or RGB inputs to linear and angular velocity. The learned policies are deployed on two robots, an AgileX Hunter SE and a Unitree Go1, both can learn to exhibit collision avoidance behavior (Fig. 3).

As our sensor suite allows social robot navigation researchers to collect data anywhere at anytime, we will demonstrate our data collection process live with conference attendees at IROS 2023 in Detroit to show the community how easy it is to set up and collect human navigation behaviors. We will also demonstrate the collected social human navigation data in real time.

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¹<https://github.com/RobotiXX/MuSoHu-data-collection>

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