

FRR: CAREER: Human-Inspired Multi-Robot Navigation

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Goal

- Advancing the next generation of indoor, mobile service robots that can be seamlessly integrated into our homes and workspaces

Key challenge

- Enable efficient and socially intelligent robot navigation in homogeneous and heterogeneous settings



Image: <http://recode.net/>

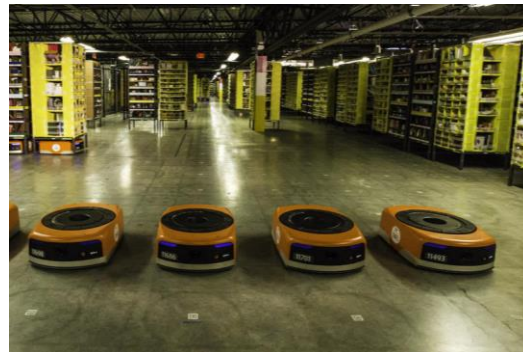
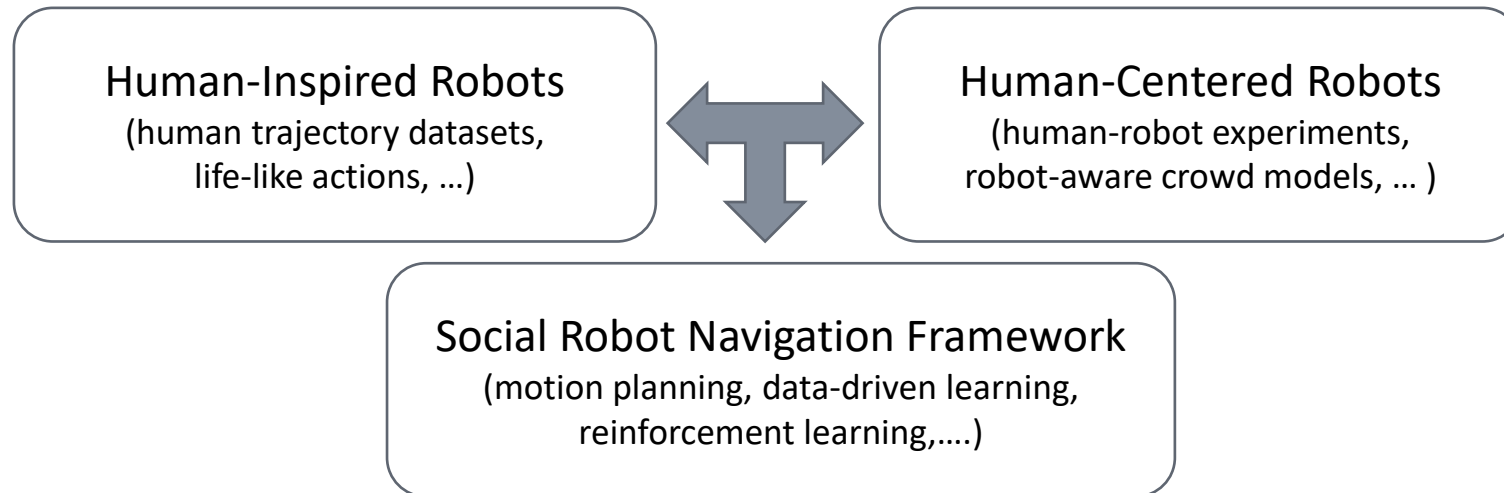


Image: cnet.com

Towards “thinking”, socially-intelligent service robots

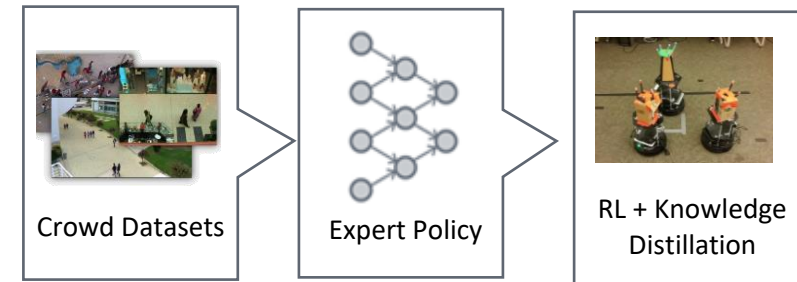
- (i) Leverage human trajectory data to improve the efficiency of robot-robot interactions
- (ii) Leverage our own human-robot interaction experiments to extend robot navigation to human populated workspaces



Ongoing work: Human-inspired multi-agent navigation using knowledge distillation

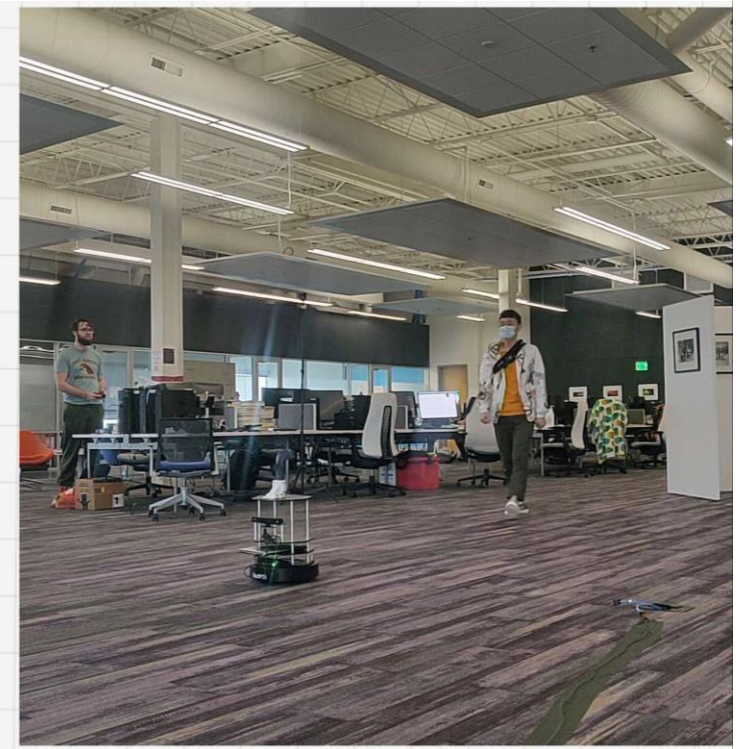
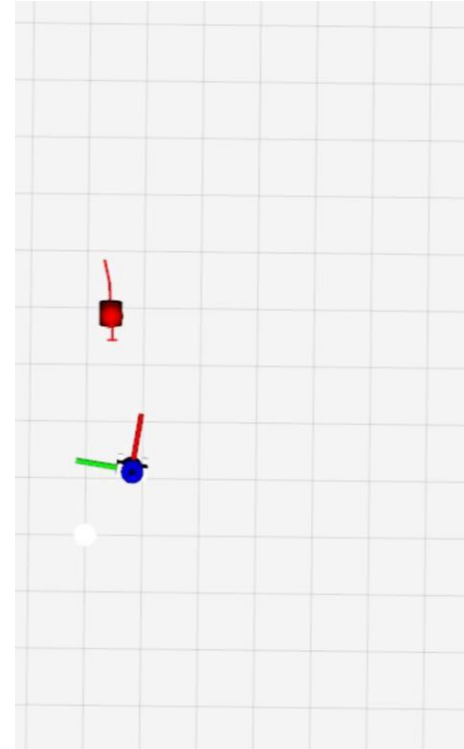
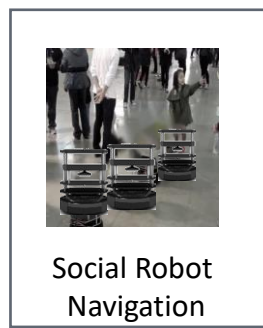
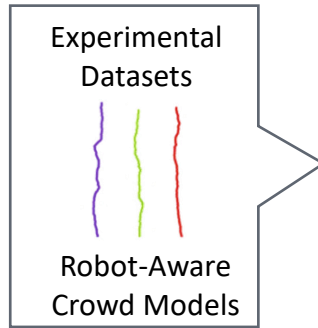
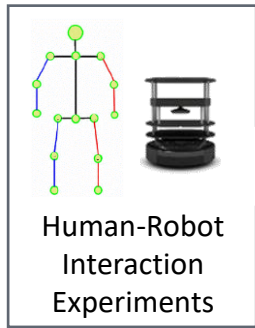
Human-inspired robot navigation in homogeneous settings
[Xu and Karamouzas, IROS 2021]:

1. Learn “expert” policy from human trajectory data using supervised learning
2. Train general action policy for multi-agent navigation using RL
 - Utilize the expert policies via implicit knowledge distillation
 - Reward function
 - High reward if agent reaches the goal + high penalty if it collides
 - Knowledge distillation term that promotes expert actions



<https://motion-lab.github.io/KDMA>

Preliminary work: Human-centered robots



Broader Impact

- Advancing the use of "thinking", mobile robots to enrich our quality of life and work
- Disseminating findings through open source code and by sharing experimental datasets
- Promoting the multidisciplinary of robotics and inspiring the next generation of students in the EPSCoR state of SC

Education Plan

- New undergraduate and graduate robotics courses
 - Deep Reinforcement Learning (Spring 2021)
 - Social Robot Navigation (Summer 2022)
- Outreach to K-12 schools in Charleston Metro Area & Upstate SC



Thank you!

Students



Alex Day



Foram Joshi



Zach Russ



Pei Xu

Publications <https://motion-lab.github.io/>

1. P. Xu and I. Karamouzas, “*Human-Inspired Multi-Agent Navigation using Knowledge Distillation*”, IEEE/RSJ International Conference on Intelligent Robots and Systems, 2021. 10.1109/IROS51168.2021.9636463
2. P. Xu, J.B. Hayet, I. Karamouzas, “*SocialVAE: Human Trajectory Prediction using Timewise Latents*” (under submission)
3. F. Joshi, “*Learning Multi-Agent Navigation from Human Crowd Data*”, MS Thesis, Clemson University, 2021.

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