Oregon State Collaborative Robotics and Intelligent Systems (CoRIS) Institute

# ROBOTICS TO IMPROVE PATIENT CARE FOR HIGHLY INFECTIOUS DISEASES

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## MOTIVATION

The outbreak of Ebola Virus Disease (EVD) in West Africa from 2012 to 2016 affected over 28,500 people, and caused 11,325 deaths. More recent outbreaks in the Democratic Republic of the Congo have added over 350 new cases and almost 200 fatalities. Many of those deaths can be attributed to the lack of a sufficient level of patient care. Local health care professionals and foreign non-governmental organizations (NGOs) such as Médecins Sans Frontières (MSF) were often overwhelmed with the number of patients. This was exacerbated by the environmental conditions in affected areas: health care workers wore extensive personal protective equipment (PPE), but could only remain it in for about 40 minutes before they succumbed to the heat and humidity.

This project seeks to answer the question: Can we use robots, automation, and optimization to both improve the quality of care delivered to patients in a future outbreak of Ebola while reducing the infection risk that the health care workers are exposed to?


## GOALS

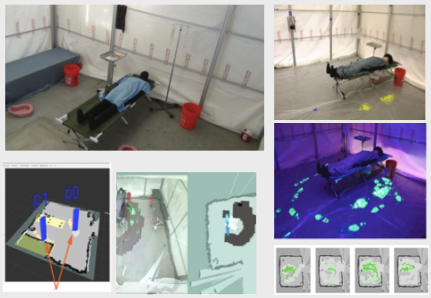
The main goals of this project are to:

1. build a full-scale simulated Ebola treatment unit (ETU), and hire local nursing students to staff it for experiments;
2. model and optimize current Médecins Sans Frontières treatment procedures;
3. develop appropriate task-specific metrics and measurement instruments; identify high value tasks and subtasks; and
4. investigate and evaluate the automation of high value subtasks.

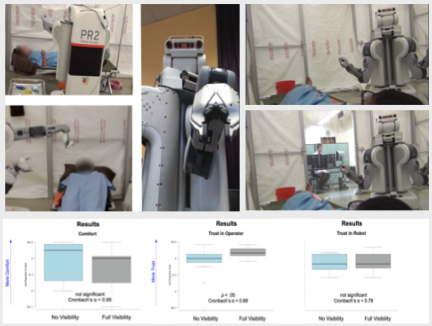
The project builds directly initial on work done under another NRI awards, RAPID: Teleoperated Robot Systems in Support of Health Care Workers (IIS 1518652) and a supporting REU supplement (IIS 1450483). We work with MSF staff who led the Ebola response to the recent West Africa outbreak, to ensure our work is relevant and grounded in real operational needs

## PREVIOUS WORK

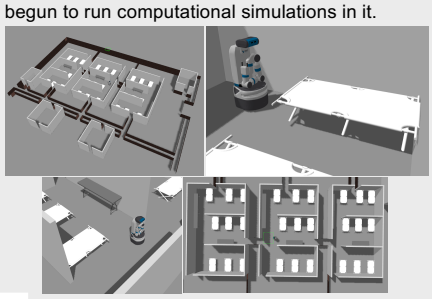
We built a small-scale **simulated Ebola Treatment Unit**, and instrumented it with sensors to perform **infection tracking,** using a grid-based probabilistic technique.



We also conducted a **study on the effects on comfort and trust** of using a teleoperated mobile manipulation robot in the ETU setting. The main finding is that people were more comforable and trusting of the technology when they could directly see the person controlling the robot.



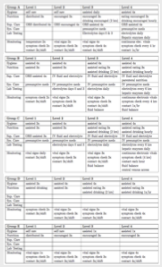
We have recently completed a high-fidelity simulation of an MSF ETU in Gazebo, and have begun to run computational simulations in it.



## CURRENT WORK

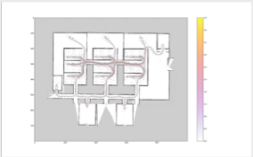
We are now in the process of building a **larger simulated ETU, to MSF specifications**. We will make our building plans, materials list, and the simulation available to the community, so that others can replicate our experiments.

We have **selected a patient care task**, involving feeding and vital sign measurement as the initial task to model. We are currently working on translating the guidelines in MSF documents into a form over which we can do planning and optimization. This has proven to be a slow process, due to the nature of the documentation and on-going Ebola outbreaks

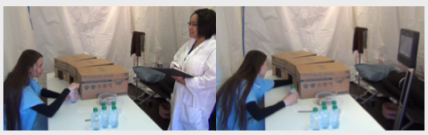


Our initial work is focusing on tasks with stochastic transition completion times. We build these completion time distributions empirically, observing the task performance of both human and robot agents. We plan to investigate algorithms that are risk sensitive, optimizing worst-case performance or minimizing completion time variance, in addition to the more traditional expected-time minimization.

Reliability of robot systems is a major concern for MSF, since many tasks in the ETU setting are time-sensitive. We are looking at how to **characterize areas that are problematic for navigation, and how to autonomously improve performance in these areas**.



We are performing experiments on the **use of telepresence robots in the ETU setting**. In particular, we are looking whether people are as willing to follow physician instructions when using a telepresence system.



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