Participant Observer Ethnography in Disaster Robotics

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Figure 1: The author, sitting, taking notes during the use of uncrewed marine vehicles at the Great Eastern (Tohoku) Japan Earthquake and Tsunami.

ABSTRACT

This paper describes the use of Participant Observer ethnography for human-robot interaction in disaster robots. It summarizes the author's experiences with ethnography for disaster robotics beginning with the 2001 World Trade Center collapse, continuing through 29 additional disasters, most recently Hurricane Ian. These experiences support the view that ethnography is of epistemological benefit to HRI and that Participant Observer ethnography may be the only practical and ethical methodology to collect HRI data during disaster response. The paper concludes with a checklist for determining if Participant Observer ethnography is appropriate for a deployment and a list of recommendations for how to structure the ad hoc data collection and analysis.

CCS CONCEPTS

• **Human-centered computing → User studies**.

HRI, June 03–05, 2018, Woodstock, NY

ACM ISBN 978-1-4503-XXXX-X/18/06
https://doi.org/XXXXXXX.XXXXXXX

KEYWORDS

human-robot interaction, ethnography, empirical user studies, field research

ACM Reference Format:
Robin R. Murphy. 2024. Participant Observer Ethnography in Disaster Robotics. In *Woodstock '18: ACM Symposium on Neural Gaze Detection, June 03–05, 2018, Woodstock, NY*. ACM, New York, NY, USA, 5 pages. https://doi.org/XXXXXXX.XXXXXXX

SHORT PARAGRAPH FOR THE WORKSHOP

My intent in submitting and participating in the workshop is to reflect on the need to encourage the HRI community to recognize three aspects of HRI ethnographic research in disasters and similar domains. One is to reduce the barriers to publishing holistic qualitative research and descriptive analyses of HRI in the field to complement and inform the quantitative and replicable, but more narrow, studies that are favored by reviewers. The second is to avoid unrealistic expectations of transferring HRI methodology, including multi-source ethnography, to disasters and similar infrequent or dangerous work domains. The third aspect is for researchers to be aware of the ethical ramifications of prioritizing research observation over participation in the participant-as-observer role for disaster management.

1 INTRODUCTION

The exploration of HRI in robots used during disasters was one of the original research thrusts in human-robot interaction, as seen at the 2001 DARPA/NSF workshop [3] that established the community [4]. It is important because of the societal benefits of faster, better uses of robots during a disaster, but also because the extreme scales of time and location, operations in adverse environments, and off-normal missions serve as "canary in the coal mine" events that may reveal insights about HRI sooner than would have been encountered in normal operations where problems can be more readily smoothed over.

Disasters are challenging for HRI field research for at least five reasons:

- Disasters occur infrequently.
- They have a short-duration as the life-saving response phase is typically only three days to two weeks long before operations turn to recovery.
- The operations are resource and personnel constrained; by definition a disaster exceeds local resources.
- They are non-repeatable.
- The pose an adverse environment, or work envelope, for humans and robots.

Taken together, disasters are not amenable to laboratory or statistical replication, nor, as well be discussed later, amenable to laboratory-oriented HRI methodologies. They are also not amenable to ethnographic methodologies that insert multiple personnel and observe over months, see [2] for an example.

2 EXPERIENCE CONDUCTING PARTICIPANT OBSERVER ETHNOGRAPHY AT DISASTERS

Although I am university professor and researcher, I am a trained responder and was originally with Florida Urban Search and Rescue Task Force 3. I have participated as a technical search specialist in 30 deployments of ground, aerial, and marine robots to disasters in 5 countries through the Center for Robot-Assisted Search and Rescue since 2001 (the 9/11 World Trade Center collapse). I have conducted Participant Observer ethnography at each, with summaries of findings and methodology for deployments before 2013 compiled in Disaster Robotics[5]. Following Burgess' definitions of the four roles within Participant Observer emic (inside the group) ethnography [1], I serve in the *participant-as-observer* role. However, my work in the participant-as-observer role differs from the definition, which states the priority for the ethnographer is observational research. In the case of disasters, the priority has to be participation; the literal life-and-death impacts of using robots to accelerate the disaster response outweighs data collection.

In addition I have led three drone deployments where researchers were allowed to observe: Hurricane Harvey, the 2018 Kilauea volcanic eruption, and Hurricane Michael. The researchers at Harvey and Kilauea served in the *complete observer* role, but at Hurricane Michael, the researcher served as an *observer-as-participant*. Their intent had been to be a complete observer but, as is typical, the deployment was short staffed and extra hands to help with tasks was an obvious benefit. While the researcher sacrificed the advantages of being detached from the informants, it actually increased the number of informants who were willing to perform a PVT test. I observed my fellow drone pilots treat this as a quid pro quo; the participants felt obligated by the researcher pitching to help, especially with tedious odd jobs, to return the favor and help their research.

None of the researchers, including myself, have served in the *complete participant* role, which means we would have hidden our intent to use the experience for data collection. The complete participant role is akin to spying on the responders using robots and threatens relationships and gives all researchers a bad name.

3 EPISTEMOLOGICAL UNDERPINNINGS AND GOALS OF PARTICIPANT OBSERVER ETHNOGRAPHIC STUDIES FOR DISASTER RESPONSE

Participant Observer ethnography was initially treated as a core HRI methodology, but recent difficulties in publishing suggest a shift from the HRI goals outlined in the founding workshop.[3] Rather than belabor the advantages and disadvantages of Participant Observer ethnology, the epistemological value is that it is the only practical and ethical way to collect data during a disaster. These types of problems described below highlight the advantages of an emic participant-as-observer with a couple of pens and a notebook to jot observations down in over an etic observer relying on cameras and electronics.

3.1 Practicality of Participant Observer for Disasters Response

Participant Observer ethnography is the only practical means of obtaining holistic HRI data for disasters. If the researcher is a responder who is participating within the response enterprise, the research is not subject to the considerable constraints on the number of responders and their limited resources of food, water, shelter, sanitation, fuel, transportation, electricity, and internet. If the researcher is opportunistically attempting to participate, they may not be able to take advantage of the opportunity due their prior commitments and use of equipment for other projects.

3.1.1 Informant and Response Resource Constraints . It is unrealistic to expect to embed researchers and desirable data collection gear (laptops, cameras, voice recorders, tripods, etc.) into a robotics team. One reason is that disasters are resource limited, with the affected population often without food, water, shelter, fuel, transportation, electricity, and internet. Responders are similarly constrained, typically carrying only backpacking levels of supply and their own fuel and generators. In Hurricane Katrina, all rescue teams working out of the Stennis Space Center in Mississippi ran out of gas and diesel for their vehicles and generators and were waiting for 24 hours. Wireless communications bandwidth dedicated for responders is generally immediately exceeded. The point for researchers is that an agency or response team is unlikely to have extra gear, food and water, transportation, generators, or internet to share with a group of researchers. Expecting to use someone else's generator or battery bank strains relations between informants and observers. The USB charging port in a SUV is one of the most valuable items to a team and is in constant use; there is rarely enough ports and power to charge essential phones and devices. Yet if a research team has a

generator, an SUV or similar vehicle, boxes of food and water, and sleeping bags, they still may not be allowed to participate because the agency having jurisdiction (AHJ) does not want to assume liability and because it is just too much overload to the management team.

A second constraint is operations: data collection and researchers interfere with operations. HRI observers have to invade personal space in order to hear or see over the pilot's shoulder, increasing the pilot's fatigue and annoyance; otherwise there are large gaps in data collection. It is unrealistic to expect responders to answer detailed surveys, incorporate new procedures on the fly, and wear ergonomically distracting gear. At the Louisiana floods in 2016, pilots were asked to fill in a repetitious 15 page survey adapted by a sponsoring agency from aviation and NASA HRI surveys as a condition of using certain models of drones. By the second day, the pilots, tired and wanting to focus on eating while trying to be helpful asked if there was anything in particular they should say they would help the research and could I as the researcher (who as a participant was also desperate to eat a hot meal) fill it in for them.

What works for an hour in a laboratory is unlikely to work in the field as documented in [7]. For example, at Hurricane Harvey, pilots were asked to wear a chest strap with a heart rate monitor, nicknamed man-bras. This did not go well. The straps did not have a range of sizes so were too tight for some heavier pilots. There were male and female pilots but no place to easily remove shirts, have a researcher adjust, and redress while maintaining privacy. At the Kilauea eruption in 2018, the observer asked pilots to wear an empatica watch on their dominant hand and press the stem at the start and stop of each flight in order to record biometric data. Both the device and procedure were new to the pilots. Pilots typically wear a personal wristwatch on their dominant hand to use for recording takeoff time, estimating flight duration, etc. The pilots initially, though grudgingly, complied. Unfortunately by the second day of 14+ hour shifts and working in the hot sun, the plastic watch bands were chafing almost everyone's wrists and were too uncomfortable to continue wearing. The data was not as valuable as hoped because none of the pilots consistently pressed the stem to mark the beginning and end of the flight. At Hurricane Michael a few months later, the empatica watchers were used by the same pilots but without the need for pressing the stem to mark flights. Unfortunately the data was lost due to host computer glitch. At both Kilauea and Michael, the responders were asked to take a PVT attention test on a phone when they returned to the forward operations base. Pilots often refused or tried to avoid the researcher as the PVT added took significant time, which preventing them from charging and maintaing the drones (which was their first priority as we could be called out at any minute), eating dinner (second), and sleeping (third).

A third constraint is on what kinds of data can be collected and used. Any data collected in the field belongs to the agency having jurisdiction (AHJ). Researchers have to request or have prior agreement on what they can use and under what circumstances, for example, no public release of any imagery with personally identifiable information (PII). Some agencies do not want any photographs or video taken of work in the field for fear it will make the agency vulnerable to a zealous OSHA inspector. Individual responders may object for the same reasons.

3.1.2 Observer and Research Resource Constraints . While the informants and the resource constraints of a disaster impose challenges for HRI research and multi-source Participant Observer data collection, researchers have their own constraints. Disasters are unpredictable and the response has a short duration so researchers may not be able to immediately field a HRI team in time to participate. It is impractical to send out researchers with no notice and to expect to take equipment probably in use for other research. This suggests that the only researchers that can realistically be expected to participate and have appropriate equipment (if any) are those who are trained responders inculcated into disaster management.

3.2 Participant Observer as the Ethical Choice for Disaster Response

The ethics of conducting research during a disaster can be reduced to four concerns. Are the research outcomes worth the additional hardships they will impose on the already stressed locals? Will there be clear research outcomes or is this disaster tourism looking to familiarize the team with the work domain and hoping something interesting will pop up? What is the risk to observer safety? What risks to informant safety do the observers introduce to informant safety?

An ethical question is whether the researchers are worth displacing one or more families from shelter and basic services. For example, at Hurricane Harvey, drone pilots from all over the country self-deployed to Texas, taking motel rooms that could have gone to families. Several Fort Bend county workers and their children had no choice but to sleep on the floor in offices in the county office of emergency management while the drone pilots posted pictures of drinking after a day of flying in violation of FAA airspace restrictions.

I usually receive requests from researchers or start-up companies to embed with CRASAR. The benefit to the response compared to the social cost is unclear. This is sometimes called *disaster tourism*, where researchers and companies view a disaster as an opportunity to collect field HRI data with their robots, even though sending one or two robots is unlikely to make any difference. During the Great Eastern Japan (Tohoku) Earthquake and Tsunami response, the CRASAR robot team was held back for a week despite written request from three Japanese cities for marine robots because Japan had been flooded with civil engineers from the US who were there to inspect the damage; the influx of engineers were competing for basic resources with the locals. The Japanese government requested that NSF delaying funding and travel approval to allow the population to be taken care of and also because it was insulting to think that Japanese civil engineers were incapable of collecting appropriate data.

In addition to the ethically compromised disaster tourism phenomenon, there are two other examples of why Participant Observer ethnography is the most ethical option for HRI research at disasters. These two are: *observer safety* and *informant safety*.

Observer safety is a real concern. The extreme conditions and stretched emergency resources pose real danger to anyone in the area of operations. The responders using robots are trained to handle the extreme conditions, to be self-sufficent, and have first-aid capabilities as medical responders will be busy elsewhere and may

not be to arrive quickly to even the most serious conditions. The team leader has the responsibility for the safety of everyone in the field from his group. As team leader, I judged the risks at the Oso Mudslides from secondary mudslides and quicksand and the Kilauea volcanic eruption from gas and lava to warrant keeping anyone who was not a participant (drone pilot trained for disasters) at the forward operating base out of harm's way. Besides personal risk, the squad leaders could not manage their safety and that of an untrained person without extra effort that would likely distract them and degrade their performance. It should be noted that observers themselves may unexpectedly decline to embed with robot response team. At one disaster, a post-doctoral researcher elected at the last minute to not deploy on the grounds of safety, which was frustrating because the post-doc position was explicit for field work. Ironically, that particular event had very little risk, which is reminder that risk can be an individual perception and what a manager may think is fine, a subordinate should be free to disagree.

Informant safety is another risk. As mentioned in the previous paragraph, an observer who is not trained in disaster response and safety, just by being untrained, and thus unpredictable, may distract the team and induce unsafe conditions. The observer, should they react inappropriately to an emergent unsafe condition, may endanger the informants or require them to endanger themselves to provide aid and assistance.

3.3 Difficulties with Publishing

Although the value of Participant Observation ethnography is clearly within the original scope and goals of the human-robot interaction community, it is difficult to publish reports. The inability to publish makes it harder to obtain funding to investigate HRI gaps identified in the report through a staged world experiment; ethnography is good at identifying potential gaps in fundamental understanding that necessitate further research. But it can be difficult to write successful proposal to address a potential gap that has not been previously identified as a gap.

The attributes most commonly mentioned in the negative reviews are that the results are qualitative not quantitative, they are not not statistically significant, and were not obtained with laboratory-oriented methodologies. It is as if reviewers view ethnography as a poor substitute for quantitative methodologies, not as a methodology well suited for specific situations and providing complementary data. Oddly, the negative reviews typically do not dispute the value of the content or the quality of the subjective narrative. It is that the paper uses ethnology to generate a subjective narrative providing a holistic description, not whether it is informative or well-written, seems to be the sticking point.

4 RECOMMENDATIONS FOR CONDUCTING PARTICIPANT OBSERVER ETHNOGRAPHY AT DISASTERS

I conclude by shifting from a defense of Participant Observer ethnography to lessons learned about when to use ethnography and how to structure data collection.

4.1 Deciding Whether Participant Observer Ethnography is Appropriate

Possibly the biggest question in Participant Observer ethnography is whether it is actually a viable option. This may be a helpful checklist:

- What is the motivation for Participant Observer ethnography? Is the desired data holistic or is it hoped that ethnography will point to something that can be explored in a quantitative staged world study? Participant Observer ethnography may be a disappointment if it is used as a substitute for a quantitative study rather than as a holistic study.
- Which of the four roles will the researcher play? Participant-as-observer may be the most practical but requires a great deal of investment by the researcher. Complete participant requires the same investment but introduces ethics. Observer-as-participant may be inevitable versus complete observer.
- Is the researcher trained, equipped with proper clothing and gear, have field or camping experience, and mentally prepared to work in austere environments around human suffering? The idea of being a field researcher may be more appealing than the reality.
- What is the risk of the researcher disrupting the response activities? If data collection is intrusive or distracting, it may interfere with life and death situations.
- What is the risk of alienating responders and making it harder for researcher, and future researchers, to conduct later studies? It is very easy to get a bad reputation and that reputation taint all HRI researchers.

4.2 A Methodology for Structuring Data Collection and Analysis

A structure is helpful for grounding the ad hoc qualitative observations, even though the exigencies of a disaster may prevent a complete capture. My notes and daily analysis for disaster deployments typically attempt to:

- Describe the use of the robots roughly following the five phases of cognitive work analysis [9]: what was the work domain, what were the primary control tasks, what strategies were used to accomplish the tasks (such as autonomy), what was the socio-technical organization of how tasks were assigned, performed, and the results transmitted, and what were the operator's competencies and backgrounds.
- Document instances of human error, both mistakes and slips following Norman's error taxonomy [6],
- Capture workarounds [10], specifically what were the barriers to using a robot and how the human(s) coped,
- Note the relative position of the operators to each other and what they were communicating to each other through what channels (verbal, non-verbal) and mechanisms (direct dialog, over a radio) following [10],
- Note the displays or user interfaces, whether they are offering egocentric or exocentric viewpoints [8], and is the viewpoint and supporting visualizations appropriate for the task,

- Gather multiple sources of documentation: mission logs, daily after action reports, robot-eye video and products, and any snapshots of the work envelope and interesting activities.

5 ACKNOWLEDGMENTS

This work was supported by multiple grants from the National Science Foundation, most recently CMMI-2306453. The author would like to thank the many students and colleagues who have collaborated in this line of research.

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