Expression Synthesis on Robots

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Robots are increasingly moving from industrial to domestic contexts. These robots are being used to serve as health aids and companions, help with household chores, and provide education and entertainment to their users. However, most robots on the market today are not particularly easy to use or understand.

To address this problem, many researchers in the field are trying to support *natural interaction* with robots. The goal is to make it as easy to interact with robots as it is to interact with other people by supporting the full range of human communicative cues (i.e., verbal and non-verbal). This is a difficult, multi-disciplinary problem that spans many areas of computer science, cognitive science, and the social sciences. It requires the ability to accurately characterise how humans interact with one another so that robots can be programmed to appropriately recognise or synthesise such behaviours themselves. It also requires robots to have at least a rudimentary understanding of the social context in which they are placed.

My research tackles a piece of this larger problem, and explores the question of how to best synthesise human-like communicative cues across several different robot morphologies with varying levels of expressivity. Synthesis is only part of the problem, however. It is also necessary to validate that these synthesised expressions are comprehensible to people. Thus, my work also explores novel methods for evaluating people's perceptions and expectations of robots across various interactive contexts, including empathy, cooperation, and social facilitation.

This work has led to several contributions. First, when developing robots that will interact in real-time with people, assumptions about which communication channels are important and worth sensing can be highly variable and person-dependent. Also, it is very difficult (if not impossible) to build robots that autonomously respond appropriately to people without understanding the underlying semantics of what they are saying

Second, I have characterized how individual differences in interpersonal sensitivity play a major role in how people understand and respond to robot non-verbal communicative cues. In particular, people's speed at decoding humanoid robot gesture is significantly correlated with their ability to decode human gesture, and having negative attitudes toward robots is strongly correlated with a decreased ability to decode human gestures.

Third, I have found that attitudes toward robots are shaped by prior beliefs and expectations which can be predicted to some degree, on areas including cultural beliefs, sensitivity to disgust, and science fiction film viewing. All of these factors may play a significant role in interaction and robot acceptance.

Finally, I explore an entirely novel use of expressive robots, and that is their use as simulated patients in clinical communication training contexts. I collected naturally-evoked facial motion data from several people with different movement disorders, and synthesised the movements of one on a highly realistic android robot. This research lays the groundwork for building a high- fidelity, expressive patient simulator for clinical domains.

This dissertation concludes by noting that while we have a long way to go to building truly socially intelligent machines and supporting natural interaction with them, there are many things we can do in the meanwhile to help improve their acceptance and use.