SYDE 750 Topic 38 / ECE 750 Topic 35, ECE 493Topic 26

Abbreviated title: **Social Robotics**

Full course title:
Social Robotics - Foundations, Technology and Applications of Human-Centered Robotics

(Winter 2022) Fully In-Person (will move online if necessary due to Covid-19), Day/time
██████████████████████

Prof.   Kerstin   Dautenhahn   ████████   x31455   kerstin.dautenhahn@uwaterloo.ca

Text: Textbook chapters (as PDF available online): Bartneck, C., Belpaeme, T., Eyssel, F., Kanda, T., Keijsers, M., & Sabanovic, S. (2020). Human-Robot Interaction – An Introduction. Cambridge: Cambridge University additional. Additional readings will be made available to students.

Home Page: SYDE 750 Topic 38 / ECE 750 Topic 35, ECE 493Topic 26 on Learn

Class Times: ██

The course will provide an introduction to the research field of social robotics, with a particular human-centered perspective. Human-robot interaction is a highly interdisciplinary area of research that takes inspiration and adopts methods from a range of disciplines, including social sciences, ethology, primatology, developmental psychology, computer science, engineering and Artificial Intelligence. Robots that can interact socially in an effective and acceptable manner with people have become increasingly important for applications ranging from robot-assisted therapy for people with special needs, robotic assistants for older people and care home residents, robots as tools in education or robotic co-workers for a new generation of industrial robot that emphasize human-machine collaboration and communication. Ideas, theories, approaches and applications will be discussed and critically reflected upon. Students will gain an understanding of the concepts and theories underlying social robotics, as well as research methodologies and techniques to realize socially intelligent robots and design, plan and evaluate human-robot interaction experiments.

Course Outline:
Target topics include*:
1. Definitions of social robots and requirements of robots' social skill and their relevance to robotics and Artificial Intelligence in real-world applications
2. Examples of social robots used in human-robot interaction (sensors, actuators, how to program etc.)
3. Multimodal interaction with social robots, including verbal interaction (e.g. speech and dialogue), non-verbal interaction (e.g. gestures, facial expression) as well as spatial interaction (proxemics)
4. The role of affective expressions of social robots and modelling emotions to facilitate human-robot engagement
5. Research methods and measures for planning, designing, implementing, running, evaluating, analyzing experiments. Areas discussed include e.g. questionnaire design, interviews and behavioral measures. Different experimental designs, protocols and methods for participant recruitment will be discussed.
6. Evaluating usability, user experience and acceptance of social robots
7. Guidelines of how to write up social robotics research for a scientific publication
8. Overview of cognitive architectures for socially intelligent robots

9. Featuring interdisciplinary research in social robotics based on research from other fields, e.g. from (developmental) psychology, ethology or primatology
10. Impact of social robot embodiments, behavior and interaction
11. Roles of social robots in human society and their potential impact on society and wellbeing
12. Selected examples of applications of social robots e.g. in care, therapy, education, rehabilitation and co-worker scenarios will be discussed throughout the course
13. Ethical, safety and privacy issues as relevant to social robotics will be discussed throughout the course

*The instructor remains the right to modify the content and order of topics covered in the lectures which may be adjusted e.g. due to recent developments in the field.

Course Grading for Graduate Students:

- 20% Assignments. Two assignments will assess students' understanding of concepts, definitions, methods, methodologies, procedures and challenges in social robotics research, testing an understanding of material covered in the lectures. One assignment will be scheduled mid-term, the other one towards the end of term.
- 20% Individual discussion paper: Students will reflect on work in Science Fiction involving the concepts of social and intelligent robots, and reflect on the relevance to today's robotics technology in robotics and Artificial Intelligence. Students can choose the work and discuss the selection with the instructor. A report (IEEE Format, 4 pages maximum) will be submitted.
- 50% Individual term project: Students will implement a set of non-verbal social behaviours using the open-source 3D robot simulator Webots. The simulator already has different humanoid and non-humanoid models available that students can choose from. Students will program expressive robot behaviours based on the current literature on non-verbal human-robot interaction. Students are required to write a report that motivates, describes and discusses those behaviours in light of the state of the art literature, and *describe an experimental design for a human-robot interaction experiment* where those behaviours could be tested and analyzed. Students will not be able to conduct a human-robot interaction experiment (which goes beyond the scope of this project), so can only report on expected outcomes rather than actual results. The report should follow the structure of an HRI article. Specifically, students' reports will be evaluated based on a) the literature review demonstrating the level of knowledge in this domain, b) the relevance of the identified research questions and hypotheses, c) the depth of the proposed research program, c) the range, complexity and quality of the implemented and documented robot behaviours, d) the detailed description of the methodology used to carry out and analyze this program of work, and finally, e) a critical evaluation of possible limitations of the expected outcomes and backup plans in order to address possible delays and technical difficulties encountered during the implementation of the work. An 8-page IEEE-style formatted report, including references has to be submitted. The report will prepare students for research in social robotics or HRI. Note, those skills can also be applied to related fields of Human-Computer Interaction (HCI), Human Factors etc.
- 10% Students are required to give a presentation of their project in class

Course Grading for Undergraduate Students:

- 20% Assignments. Two assignments will assess students' understanding of concepts, definitions, methods, methodologies, procedures and challenges in social robotics research, testing an understanding of material covered in the lectures. One assignment will be

scheduled around mid-term, the other one towards the end of term.

- 20% Individual discussion paper: Students will reflect on work in Science Fiction involving the concepts of social and intelligent robots, and reflect on the relevance to today's robotics technology in robotics and Artificial Intelligence. Students can choose the work and discuss the selection with the instructor. A report (IEEE Format, 4 pages maximum) will be submitted.
- 50% Individual term project. Students are asked to write a report which consists of a proposal for an envisaged Human-robot interaction (HRI) study. It does not require any implementation of robot behaviours. Students need to identify a topic and research questions, based on what has been covered in the course, written as a research article. Specifically, students' reports will be evaluated based on a) the presented motivation of the proposal based on existing HRI work, b) the relevance of the identified research questions and hypotheses, c) the detailed description of the methodology (study design, measures etc.) that could be used to carry out and analyze this program of work, and finally, d) a critical evaluation of possible limitations of the expected outcomes and backup plans in order to address possible delays and technical difficulties encountered during the implementation of the work. Students are required to include a literature review and relevant references. An 8-page IEEE-style formatted report, including references has to be submitted. The description of a possible HRI experiment will help them understand what is required if they plan to pursue further research in HRI but also related areas such as Human-Computer Interaction and Human Factors.
- 10% Students are required to give a presentation of their project in class

Students are expected to attend all lectures, take detailed notes and participate in class discussions. It is expected that students understand the university position on copying (in terms of assignments) and plagiarism (in terms of the discussion paper and project). All material (text, figures, tables etc.) that are not your own must be explicitly identified.