

Autonomous Development of Interactive Behavior for a Humanoid Robot

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1. Unification Characteristics

- **Common Concept**
 - Interaction as a <continuous> dynamical coupling between the human and the robot.
- **Common Goal Orientation**
 - Interaction Centered Research. HRI is not about Humans or about Robots but about the interaction between them. Designing and understanding interaction is the common goal
- **Common Methodological Orientation**
 - Real World Evaluation. HRI is more sensitive to appearance, small variation in behavior etc than other Robotics areas.
 - Human Centered Design. Humans are not the consumers of HRI but a part of the challenges facing this field



2. Significance Measure

- **Real World Applicability**
 - No one can simulate a human (Yet!)
- **Principled Approach**
 - Utilizing sound techniques in design and evaluation
- **Multidisciplinary Orientation**
 - Utilizing the wealth of knowledge from fields like human-human interaction analysis, developmental psychology, neuroscience, machine learning, etc can generate more robust and principled robots

3. Synergistic research between HRI general robotics

- **Using HRI to Face General Robotics Challenges**
 - e.g. stabilizing perceptions using interaction
 - e.g. improving learning algorithm by incorporating HRI results
- **Using Robotics Solutions to Face HRI Challenges**
 - e.g. utilizing unsupervised concept formation for learning interactive behavior.

Learning Interactive Behavior

Goal

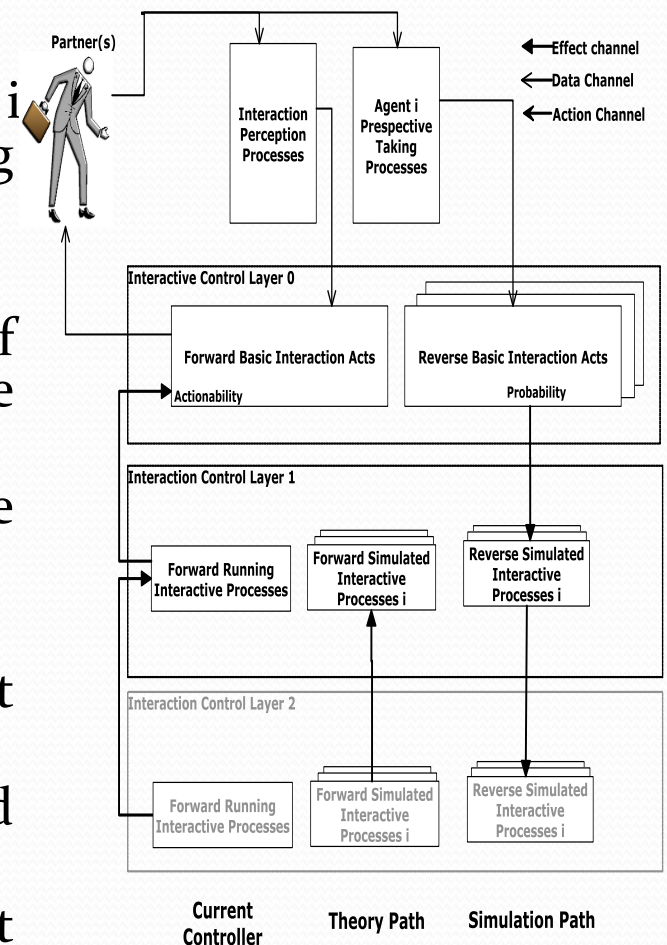
Developing Nonverbal Human-like Interactive Abilities in two stages: watching then engaging.

Traditional Approach

1. Use Human-Human data to find a set of rules for controlling the behavior of the robot
2. Manually implement these rules into the robot

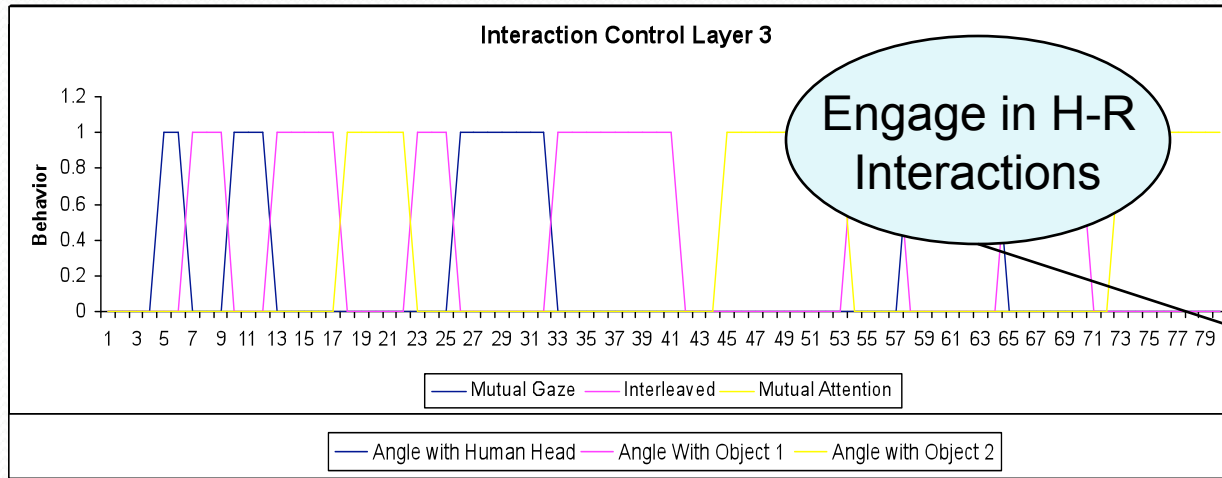
Proposed Approach

1. Design very basic motor actions of the robot (e.g. Look@Partner, Look@ObjectX)
2. Give the robot Human-Human data to build a model
3. Engage the robot in Human-Robot interactions to adapt the model.



Brief Overview

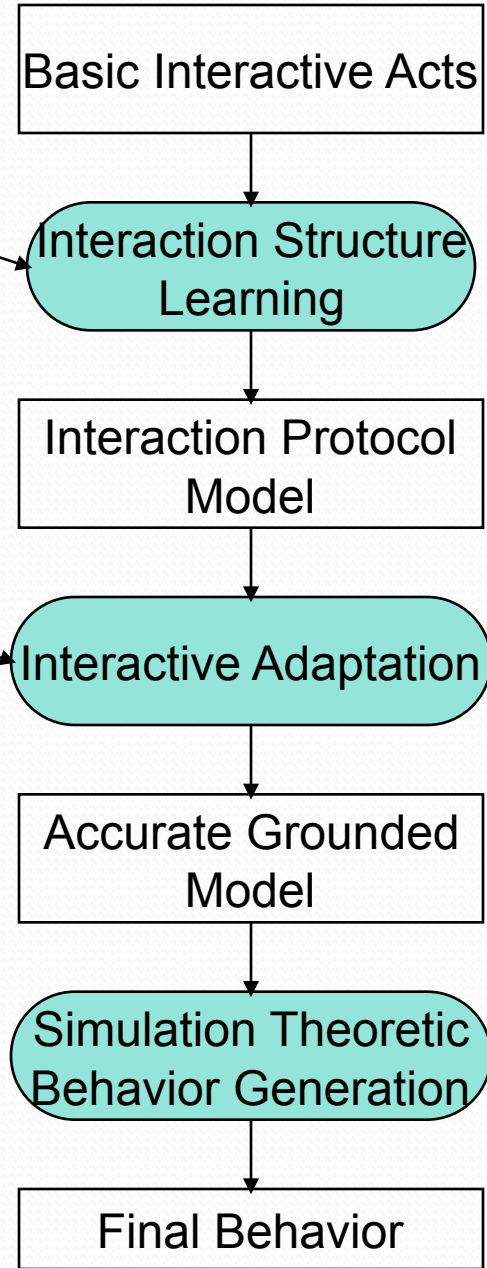
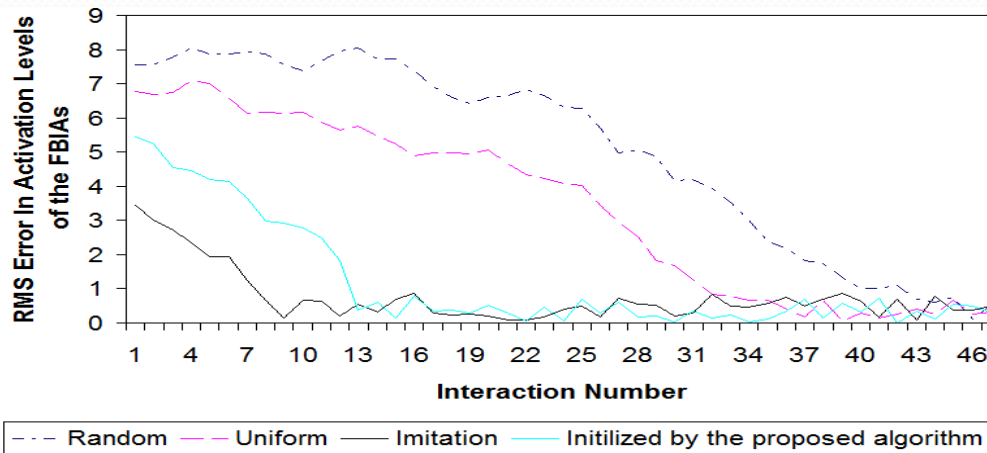
Patterns in raw data are invisible



Watch H-H Interactions

Engage in H-R Interactions

Simulation Result





Future

- Combining Verbal with Nonverbal Interactive Behavior.
- Individualizing the Model.
- Learning Basic Interactive Acts (episodes of interaction feature changes).
- Comparing Modeling by Dynamical Systems and Probabilistic Modeling.
- Testing the integration of learned nonverbal, verbal and task oriented behaviors