Robot-Assisted Feeding: From Bite Acquisition to Bite Transfer

NRI/Collaborative Research: Robot-Assisted Feeding: Towards Efficient, Safe, and Personalized Caregiving Robots
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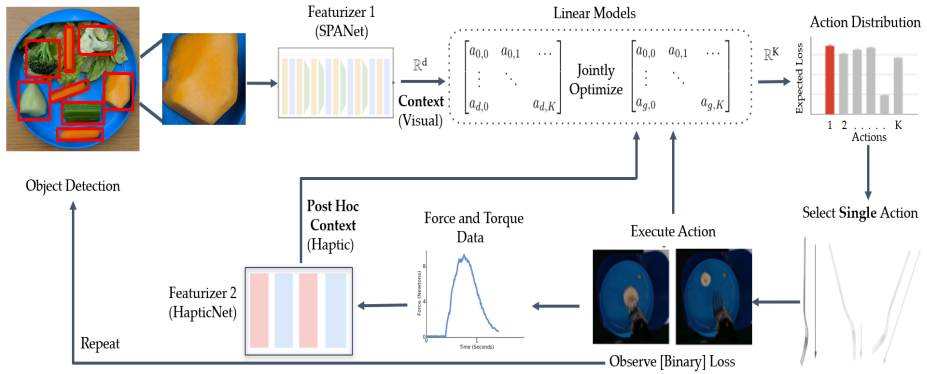
Challenge

- How to pick up previously unseen food items?
- How to balance between efficiency and comfort during bite transfer?



Post hoc augmented contextual bandit framework. We only observe the visual context from SPANet prior to action selection, but the post hoc context from HapticNet is used with the observed loss to update the visual model.

Solution

- Bite-acquisition:
  - models bite acquisition as a Contextual Bandit and collects additional haptic context during action execution for online learning
- Bite-transfer:
  - uses heuristics-guided bi-directional Rapidly-exploring Random Trees (h-BiRRT) that selects bite transfer trajectories of arbitrary food item geometries and shapes using our developed bite efficiency and comfort heuristics
  - models comfort as a conical spatial cost region based on proxemics and efficiency as percentage of food inside the mouth

Scientific Impact

- Robust autonomous acquisition of deformable hard-to-model objects with varying physical properties (food items)
- Human-aware trajectories that balance efficiency and comfort in proximity to human face (bite transfer trajectories)

Broader Impact

- 24 million people in US with motor impairments need assistance with *activities of daily living* like eating.
- Robust autonomous food acquisition and transfer increase independence, self-confidence, and caregiver time
- Results (to-be) presented in SoNIC Workshop at Cornell for under-represented minorities in the US, AI mentoring program at Stanford, various demos for middle-school, high-school, and undergraduates at Cornell and UW such as during UW Engineering Discovery Days
- Quote from a person with CI Quadriplegia: *"…**The technology allows me to do more things on my own, of course giving me more independence, making me feel more free … and gives me something to look forward to.**"*