A Penny for Your Thoughts: The Value of Communication in Ad Hoc Teamwork

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Ad Hoc Teamwork

“To create an autonomous agent that is able to efficiently and robustly collaborate with previously unknown teammates on tasks to which they are all individually capable of contributing as team members”.

Communication in Ad Hoc Teamwork (CAT)

Previously unknown teammates ≠ solo player

**Use** existing communication channels

**Learn** new communication channels

**Teach** other teachable agents

SOMALI CAT

Sequential
One-shot
Multi-Agent
Limited
Inquiry

Communication in Ad hoc Teamwork

Are you going to the green room?

Are you going to the green room?
When to Communicate

Zone of Information ($Z_I$)

Ad hoc agent may have Uncertainty about the physician's goal

worst cases distinctiveness (wcd)$^1$

$$Z_I = \{t \mid t \leq \text{wcd}_T(i,j)\}$$

$Z_I(1,2) = 1-9$

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When to Communicate

Zone of Plan Branching ($Z_B$)

Ad hoc agent must commit to goal

$$Z_B = \{ t \mid t \geq \text{wcd}_A(i,j) \}$$

$Z_B(1,2) = 6-10$
When to Communicate

Query when:
Ad hoc agent both is **uncertain** and must **commit**

Zone of Querying
\[ Z_Q = Z_I \cap Z_B \]
\[ Z_Q = \{6, 7, 8, 9\} \]

Critical Querying Point (CQP) = 6
Methodical evaluation
Methodical Evaluation
Experimental Setup

- **Never**
  - Only use Bayesian inference
- **First**
  - Query at beginning of simulation
- **Z_Q**
  - Query at beginning of Zone of Querying
- **Random**
  - Query randomly during simulation
- **All vs One**
  - Query until certain vs once

50x50 grid with 100 domain instances
Results

- **Never**
  - Only use Bayesian inference

- **First**
  - Query at beginning of simulation

- **$Z_Q$**
  - Query at beginning of $Z_Q$

- **Random**
  - Query randomly during simulation

- **All vs One**
  - Query until certain vs once

![Average Marginal Cost for Various Algorithms](chart.png)
Summary

• We present Communication in ad hoc teamwork (CAT) as a novel paradigm for representing various real world tasks
• We introduce The Tool Fetching Domain as a new problem setting for representing CAT tasks
• We demonstrate that Value of communication is significantly dependent on timing
Would you like to hear more?


Expected Value of Communication for Planning in Ad Hoc Teamwork in AAAI’21

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