

Analysis of the cooperation mechanisms between agents

Partial Global Planning, Contract Net, Voting, Auctions and Coalitions formation

H. Bertiche A. Brando J. Camps M. Leyva V. Roig

¹Department of Computer Science
University Rovira i Virgili

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Outline

1 Cooperation mechanism analysis

- Partial Global Planning
- Coalition formation
- Contract Net
- Auctions
- Application to our agents

2 Application to our agents

- Cooperation among coordinators
- Cooperation of RuralAgents with their Coordinator
- Cooperation of HelicopterAgents with their Coordinator

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Cooperation mechanism analysis

Partial Global Planning

Involves **three iterated stages**:

- 1 Create local plans
- 2 Exchange local plans
- 3 Generate Partial Global Plans

Actions are incorporated into a **PGP**. Containing the following **attributes**:

- Objective
- Activity maps
- Solution construction graph

Cooperation mechanism analysis

Partial Global Planning

Involves **three iterated stages**:

- ① Create local plans
- ② Exchange local plans
- ③ Generate Partial Global Plans

Actions are incorporated into a **PGP**. Containing the following **attributes**:

- Objective
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Advantages

- Scales well with increased number of agents
- Handles dynamic environments

Disadvantages

- Each agent needs to maintain a model of the plan of every other agent.
- **Not suitable for our problem**

Cooperation mechanism analysis

Coalition formation

- Coordination of actions of several agents
- Global goal
- Several configurations
 - Centralised vs distributed
 - Internal vs external

Cooperation mechanism analysis

Coalition formation

- Coordination of actions of several agents
- Global goal
- Several configurations
 - Centralised vs distributed
 - Internal vs external

Disadvantages

- Lack of homogeneity.
- There is no guarantees on the optimal distribution.
- High number of message exchanges.

Cooperation mechanism analysis

Contract Net

Composed by 5 **stages**

- ① Recognition
- ② Announcement
- ③ Bidding
- ④ Awarding
- ⑤ Expediting

Cooperation mechanism analysis

Contract Net

Composed by 5 **stages**

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Advantages

- **Robust** to failures of agents.
- Allows to **subdivide** the task.
- Does not require external controllers.
- **Simpler** than other methods.

Disadvantages

- Cost functions and task division can lead to **complex** functions.
- Can involve unnecessary communication.
- Highly dependent on the **reliability** of task subdivisions and cost functions.
- More explicit communication is needed.

Cooperation mechanism analysis

Auctions

2 kind of **participants**

- Auctioneer
- Bidder

Typical **formats**

- English auction
- Dutch auction
- First-Price Sealed Bid
- Vickrey auction

Cooperation mechanism analysis

Auctions

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Advantages

- Knowledge about how much an item is worth not needed.
- Creates **competition** among bidders.
- Faster than negotiating a price.

Disadvantages

- Agents should meet some requirements:
 - Self-interested
 - Rational
- **Not suitable for our problem**

Cooperation mechanism analysis

Voting

- Finite number of **alternatives**.
- **Result** of the negotiation decided using the votes of the agents.
- Different **protocols**: plurality, best-worst, k-approval, binary, Borda, Condorcet...

Cooperation mechanism analysis

Voting

- Finite number of **alternatives**.
- **Result** of the negotiation decided using the votes of the agents.
- Different **protocols**: plurality, best-worst, k-approval, binary, Borda, Condorcet...

Advantages

- Some protocols \Rightarrow computationally cheap.

Disadvantages

- Untruthful or self-interested voters.
- Complex protocols \Rightarrow computationally expensive.
- **Not suitable for our problem**

Outline

1 Cooperation mechanism analysis

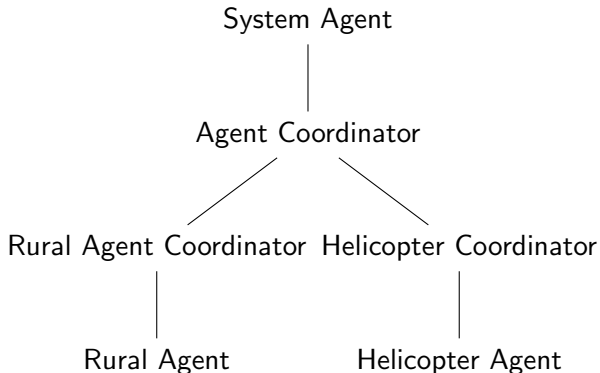
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Application to our agents

Cooperation among coordinators

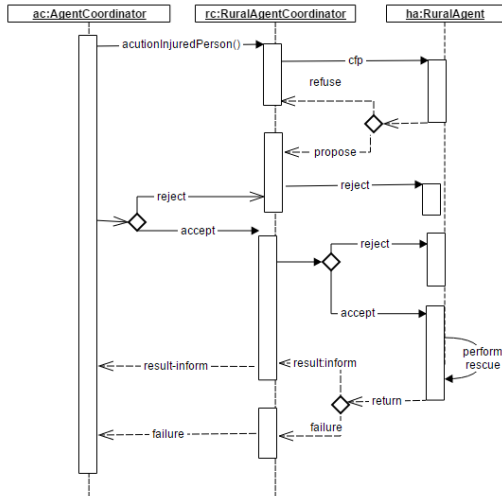


One round auction

- The AgentCoordinator acts as auctioneer.
- The coordinators bid with their best choice.
- The option with minimum cost is chosen.

Application to our agents

Cooperation mechanism of RuralAgents with their Coordinator

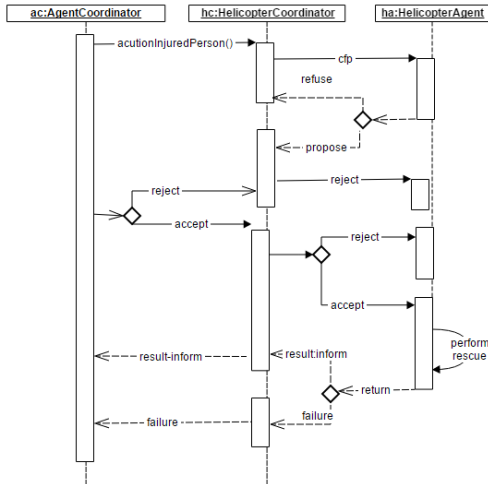


Special considerations

- Dealing with avalanches

Application to our agents

Cooperation mechanism of HelicopterAgents with their Coordinator



Special considerations

- Landing and taking off from hospitals
- Rescuing people from the same cell

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