Models for Interoperable Human Robot Collaboration

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Agenda

- Introduction
- Degrees of Human Robot Collaboration
- Representation of Tasks / Processes
- Comparison of Approaches
- Conclusions

Introduction

- Key Drivers in Manufacturing:
  - Efficiency & Effectiveness
  - Quality and Innovation
  - New: Flexibility and Adaptability
    - Human – Robot Collaboration
    - …

Human Robot Collaboration

- synchronization of the worker and robot
  e.g. through start/stop button
- Human Robot coexistence
  share a space
- Human Robot assistance
  client server relationship
- Human robot cooperation
  sharing a work piece
- Human Robot Collaboration
  share the same task, taking part in the same process

Enterprise Interoperability

- Enterprise Interoperability Concerns
  - levels of granularity
  - Data, Service, Process, Business
- Enterprise Interoperability Barriers / Problems
  - Organizational, Conceptual / Semantic, Technology
- Focus here:
  - Production Process
  - Conceptual / Semantic

Representation of Tasks / Processes

- Ontology of Enterprise Interoperability (OoEI)
  OWL Approach for Modelling Systems and EI
- OoEI extended for Complex Adaptive Systems (OoEI^{CAS})
  SCALA based implementation using akka Actors
- Subject-oriented Business Process Management (S-BPM)
  Modelling using Agents/Roles and Communication
- Framework of Interoperability for Human-Centered Manufacturing
  conceptual framework
- KnowRob
  Knowledge Representation & OWL & Prolog

Comparison

- Principle #1 - Plural nature of models
  no such thing as one size fits them all
- Principle #2 - Modeling views
  allow different foci
- Principle #3 - Three fundamental flows
  material, information and control/work
- Principle #4 - Concept of modeling levels
  levels of details

Comparison

- human-centered manufacturing interoperability framework
  - #1(Plural Nature) Not explicitly
  - #2 (Modeling Views) Yes
  - #3 (3 types of flows) No – only information
  - #4 (Modeling level) Not explicitly but recommended

Comparison

- S-BPM framework and tools
  - #1(Plural Nature) ~ two levels
  - #2 (Modeling Views) Different Roles for Agents
  - #3 (3 types of flows) No – only information & control
  - #4 (Modeling level) Only 2 Inter- subject level and subject behavior level

Comparison

- OoEI^{CAS}
  - #1(Plural Nature) DSL supports encoding of multiple models
  - #2 (Modeling Views) not a graphical approach
  - #3 (3 types of flows) Basic concepts in DSL
  - #4 (Modeling level) DSL Allows this

Comparison

- KnowRob
  - #1(Plural Nature) Only a single goal
  - #2 (Modeling Views) no
  - #3 (3 types of flows) yes
  - #4 (Modeling level) So far not considered in Ontology but possible

Conclusion

General Considerations

- Future will require complex interaction schemes to be captured
- Currently not everything can be modeled

Next Steps

- Combining automated planning with modelling
- Test environment for modelling human robot collaboration processes

EI2N 2018

- 13th OTM / IFAC / IFIP International Workshop on Enterprise Integration, Interoperability and Networking
- http://otmconferences.org/index.php/workshops/ei2n-2018

- Abstract Submission Deadline: July 3rd
- Full Paper Submission Deadline: July 10th

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