An Ethnography of Human-Robot Interaction

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Introduction

Topic
To improve human-robot interaction and management of remote operations through observations of the work practices, activities, and difficulties faced by the science team and rover team while using the rover in context.

Outline
- Method
- Findings
- Recommendations
- Next steps
Method

- **Goal:** See the world through the eyes of the people you are observing
- Simultaneous observation during remote science operations

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<thead>
<tr>
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<th>Pittsburgh</th>
<th>Chile</th>
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</thead>
<tbody>
<tr>
<td>Hours of observations</td>
<td>138</td>
<td>241</td>
</tr>
<tr>
<td>Diagrams</td>
<td>66</td>
<td>-</td>
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<tr>
<td>Photographs &amp; video clips</td>
<td>99</td>
<td>Over 105</td>
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<tr>
<td>Artifacts (e.g. science plans, screen shots, presentation slides, etc.)</td>
<td>63</td>
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Findings

Sources of miscommunications

- Inconsistent naming conventions
- Unclear and changing protocols
- Misinterpretation of the science team’s intent
- Misunderstanding the rover’s capabilities
- Priorities emphasized differently
- Missing contextual information (e.g. location, orientation, technical problems in field, etc.)
Findings

Contextual information was missing

- location and orientation of rover
- degree of rover autonomy
- technical problems in the field
- logistical constraints in the field

Which led to

- difficulty in interpreting science data
- miscommunications and errors
- erroneous (sometimes harsh) attributions about why things were done the way they were
Findings

Confusion about data products

- which data were collected where
- which data products were collected (and not)
- whether or not data products were generated from the same target

Which led to

- data that were difficult to interpret
- low confidence in presence of life
Findings

Local decision-making not a good proxy for autonomy

- Because of inherent ambiguity, technical problems, and changing environmental conditions, the rover team was forced to make local decisions on behalf of the science team

Which led to

- data that were difficult to interpret
- the science team’s not being able to predict future rover behavior
- difficulty learning how to reliably specify actions
Recommendations

For autonomy system, provide

• rationale for what is included/not in the plan
• error reports (what went wrong and why, in the science team’s language)
• the capability to prioritize a set of data products to ensure the science team has converging evidence

For Science on the Fly, provide

• data/tools that will allow the science team to efficiently verify the rover’s estimate of its position
• rationale for why data was collected
Recommendations

For management of remote operations

• Non-autonomous data collection
  • increase the amount of logistical information and information about technical problems (without revealing locational information)
  • decide how to handle the trade-off between obtaining science data and simulating rover autonomy
• Officially designate a “science team representative” in the field
What’s next

Continue data analysis
- identify and further develop findings based on patterns in the data
- formulate additional (and more detailed) system recommendations
- create new component/interface based on findings

Collect data in 2005 field season to
- develop further insights relating to HRI and management of remote operations
- evaluate autonomy system (compare with non-autonomous operations)
- investigate effects of science on the fly and new component/interface
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