MORSE & HRI: Recent Perspectives

SIMPAR 2014@Bergamo, Italy — October 2014

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What to Expect?

Our work reports on five independent applied use cases of the MORSE simulator in the field of human-robot interaction.
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Our work reports on five independent applied use cases of the MORSE simulator in the field of human-robot interaction.

We like to foster the discussion about requirements when it comes to simulation of HRI scenarios.
What **NOT** to Expect?

The *perfect* simulator for HRI studies ;}
Agenda

1. Brief MORSE introduction (foundation for 2.)
2. Simulating HRI & Lessons Learned
3. Less common Use-Case
4. Conclusion & What's Next?
MORSE INTRO

Concept

Simulation scripts (Python) → describe → MORSE

ROS.org → communicate → MORSE

sockets → communicate → MORSE

... → communicate → MORSE

MORSE → build → Blender Python API

MORSE → bootstrap → Blender Game Engine

MORSE → simulate → Blender Game Engine

MORSE → interact (optional) → keyboard

MORSE → interact (optional) → mouse
> morse create my_sim

> cd my_sim
> ls
default.py  scripts/  src/
MORSE INTRO

Usage

```bash
> morse create my_sim
> cd my_sim
> ls
default.py scripts/ src/
> morse run my_sim
```
MORSE INTRO

Usage

```python
#!/usr/bin/env morseexec
from morse.builder import *
robot = Morsy()
robot.translate(1.0, 0.0, 0.0)

motion = MotionVW()
robot.append(motion)

keyboard = Keyboard()
robot.append(keyboard)

pose = Pose()
robot.append(pose)

robot.add_default_interface('socket')

env = Environment('sandbox')
env.set_camera_location([10.0, -10.0, 10.0])
```

> morse create my_sim
> cd my_sim
> ls
default.py scripts/ src/
> morse run my_sim
> cat default.py
MORSE INTRO
Abstraction Levels

Your Software Stack

Stereovision

Terrain modeling
MORSE INTRO
Abstraction Levels

Semantic Camera
scene objects catalog
+ visibility check

Your Software Stack

house #42
at (2.3, 1.6, 0.8)
MORSE INTRO

Depth Camera Proof-of-Concept

https://vimeo.com/groups/blenderandroborotics/videos/54778108
MORSE INTRO
Fast Programmatic Scene Generation

```python
from random import uniform
from morse.builder import *

robot = PR2()

for h in range(30):
    human = Human()
    human.translate(
        uniform(-5, 5),
        uniform(-5, 5),
        0)

    human.rotate(
        0,
        0,
        uniform(0, 360))
```
Not there yet...
Scenarios

Situation Assessment

SPARK Screenshot
Scenarios

Situation Assessment
Manual testing on physical systems (cameras, MOCAP, etc) is labour-intensive
Low-cost deployment of environment perceived as beneficial
Repeatability of the experimental conditions
Important to assess the algorithmic improvements
Effectively supports collaboration between partners involved in the project
Scenarios
Expectations Framework for Domestic Robot Assistants

https://vimeo.com/groups/blenderandrobotics/videos/74440009
Scenarios
Expectations Framework for Domestic Robot Assistants - Lessons Learned

Fast setup of a large testbed by reusing the real robot control layer via ROS
First insights into the problem domain by using MORSE
Algorithms were eventually validated on the real robot in a smaller environment
Scenarios
Automated Execution of Prototype HRI Experiments

MORSE builder script

```python
robot.append(waypoint)
robot.append(semantic_camera)
... time++
robot.append(motion_xyw)
robot.append(sick_laser)
robot.append(rgb_camera)
```

gradually increase complexity

Execute scenario on **CI Server**, include evaluation scripts of experiment designers
Scenarios
Automated Execution of Prototype HRI Experiments - Lessons Learned

The interactive human avatar is useful to include a dynamic human component.
The level of abstraction of different sensors is useful to iteratively test algorithms.
Automatically run MORSE builder scripts in a CI Environment enables early prototyping.
Takes away the “pain” for non-technical staff.
Scenarios

Data Acquisition through Automatic Scene Generation
Scenarios

Data Acquisition through Automatic Scene Generation - Lessons Learned

Automatic **scene generation** by the use of Python to “**program**” the simulation scenes is useful for the acquisition of **large amounts of data**.

The generated desktop scenes will be used in web-applications to **crowdsource** natural language descriptions of object arrangements and commands for robots.
Conclusion

Programmability (simulation scenarios are Python scripts) is perceived as beneficial.

Concept of abstraction levels provides an effective way to focus simulation on a particular problem by hiding irrelevant simulation artifacts.

While HRI experiments are considered as notoriously difficult to deploy, test and repeat, we showed here how a simulator may enable automated testing of HRI scenarios.
Conclusion

Sounds/speech models are incomplete

Human models do not yet provide good enough accuracy (UI and SIM)

Interactive control of a human component, i.e., via Keyboard seems to be essential

Domestic environments, that are crucial for HRI studies are cheap to “deploy”

Experimental setups are easy to reproduce — even in other labs
Conclusion

Sounds/speech models are incomplete

Human models do not yet provide good enough accuracy (UI and SIM)

Interactive control of a human component via Kinect, Keyboard ... is essential

We are certainly **not yet there**, much remains to be imagined, refined and achieved

As an open-source project, we strive for new use-cases and ideas, and **warmly welcome** researchers that would like to **join** the effort!
Next Steps
Integrate Make Human
Next Steps

Other domains / related work

Autonomous navigation of humans as an “easy to use” external component

Crowd simulation algorithms, based on the idea of social forces [Szymanezyk et al.]

Include better libraries for motions, e.g., walk cycles, pick & place, sitting down,

Incorporate multimodal output for the human component, like speech commands

Integrate emerging Virtual Reality devices like the Occulus Rift (done, yay!)

Open MORSE to the web (WebGL), steer human in a browser, ROS, Gazebo [Breazeal et al.]
Next Steps
Other domains / related work

Embodied Virtual Agent (EVA) community usually provides higher-level functionality:

- Simulated emotion dynamics
- Behavior generation based on action primitives
- Conversational dialogue systems, and up to cognitive simulations

However, integrating these into a coherent robotics simulator with an acceptable interface remains challenging — we need to have a look at this!
Thank you!

Open "HRI" issues on GitHub:
https://github.com/morse-simulator/morse/labels/HRI

Join us!

http://www.openrobots.org/wiki/morse/

Blender and Robotics Community on G+

**Blender and Robotics**

All videos can be found here

https://vimeo.com/groups/blenderandrobotics