INF FAKULTÄT FÜR INFORMATIK

Computer Systems in Engineering

Software Development for Industrial Robots

OpenRAVE

Group: Julian Hettig, Monique Meuschke, Sarah Pauksch

Overview

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2 Installation
3 Getting starting with OpenRave
4 OpenRAVE - Programming
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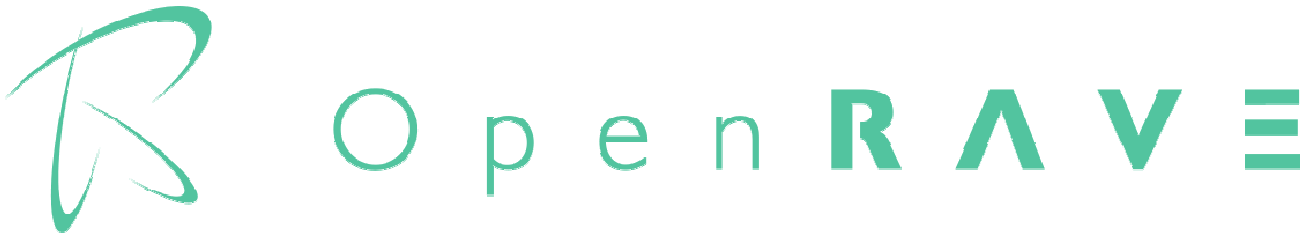


Introduction to OpenRAVE

History

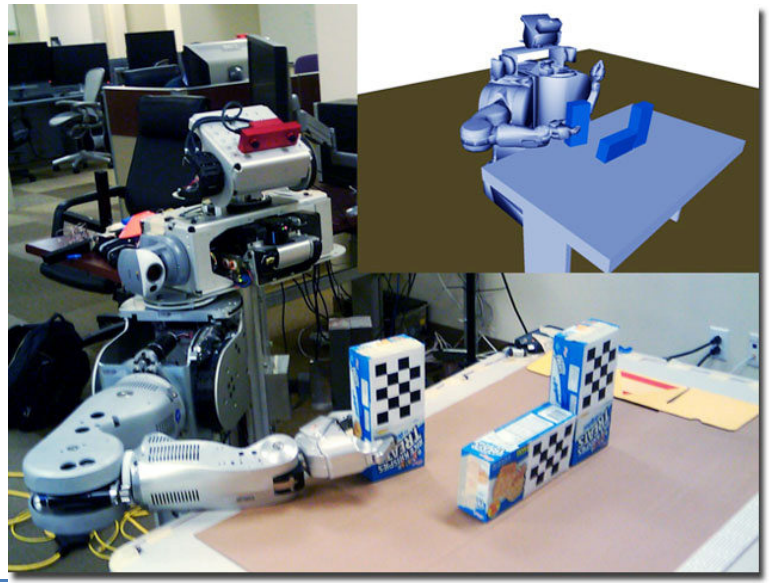
- environment for testing, developing, deploying motion planning algorithms in real-world robotics applications

- founded by Rosen Diankov at Quality of Life Technology Center in Carnegie Mellon University Robotics Institute in 2006

Rosen Diankov – Developer of OpenRAVE [OpenRave]

Introduction to OpenRAVE
Characteristics

- simulation, analysis of kinematic and geometric information related to motion planning
- easily integrated into existing robotics systems because of OpenRAVE's stand-alone nature
- plugin architecture easily write custom controllers or extend functionality
- important target application: industrial robotics automation



Application of OpenRAVE [OpenRave]

Installation
Linux (Ubuntu)

Shell-Commands for installation

- sudo add-apt-repository ppa:openrave/release
- sudo apt-get update
- sudo apt-get install openrave

Setting Environment Variable

- export PYTHONPATH=$PYTHONPATH:‘openrave-config --python-dir‘

Installation
Windows

Download link

- http://openrave.org/docs/latest_stable/install/#install

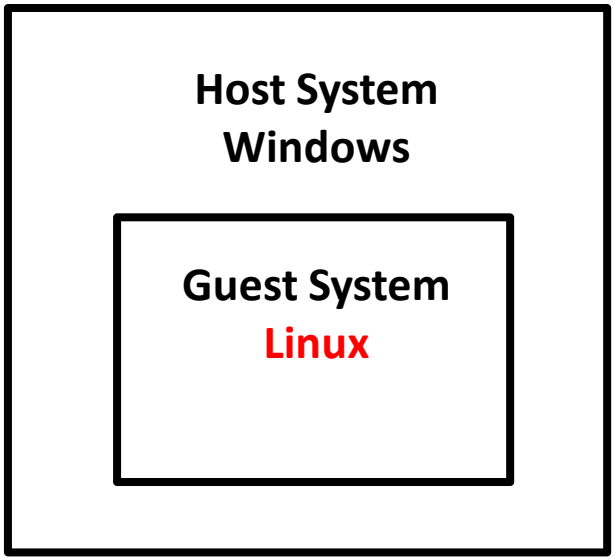
Required libs

- Boost 1.44
- Qt 4.7.1
- Python 2.6
- Python NumPy 1.6.0
- Python SymPy 0.7.1
- Python SetupTools 0.6c11 Library
- boost_xx_44.dll
- …
- **Suggestion:** use a virtual linux machine

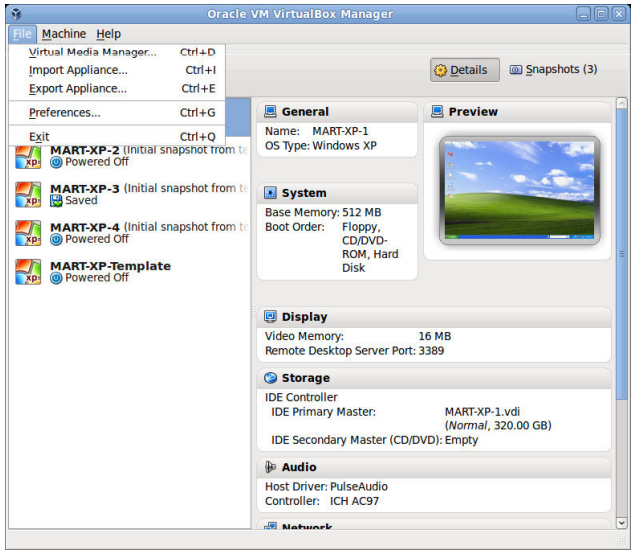
Installation
Virtual Machine

Download link

- https://www.virtualbox.org/wiki/Downloads
- Embedding given virtual machine
- File->Appliance import



Principle of a virtual machine



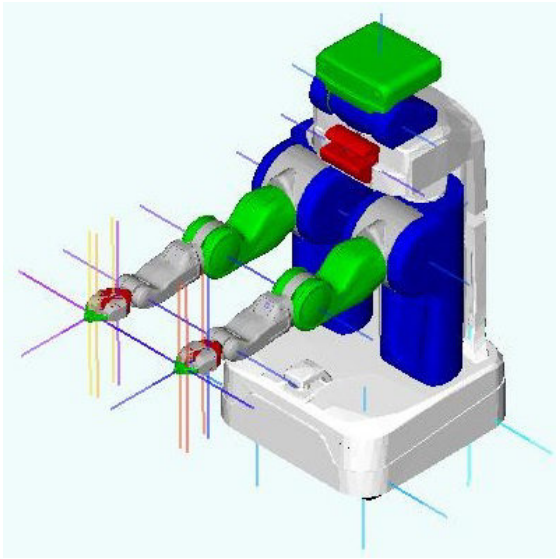
GUI of VirtualBox

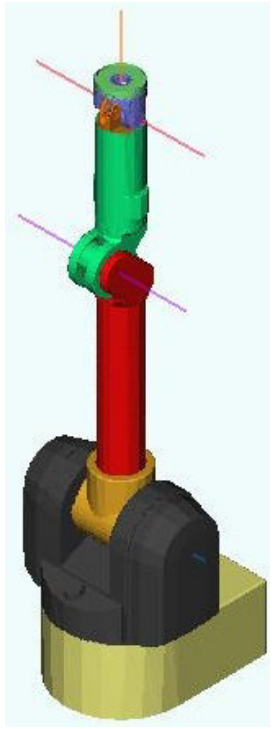
Getting started with OpenRAVE
Documentation

2 main components
- openravepy_int
- openravepy_ext

3 major subcomponents
- databases Package
- examples Package
- interfaces Package

Quick Links
- Python API
- Core C++ API
- Developers Guide





Robots from OpenRAVE Database [OpenRave]

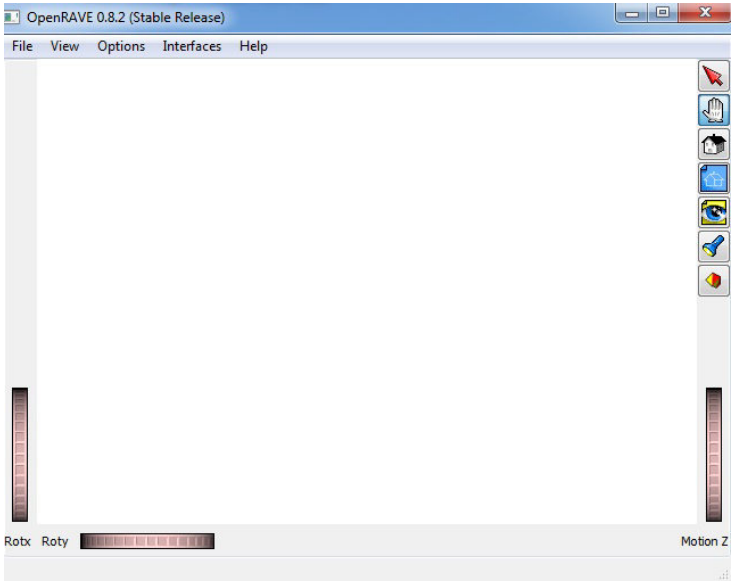
Getting started with OpenRAVE
Execution

IDLE

- Open python file (openrave.py)
- Execute with F5

Windows Command Prompt (cmd)

- Change directory to …
- Execute openrave.py



OpenRAVE GUI [OpenRave]

OpenRAVE
Programming – Basics

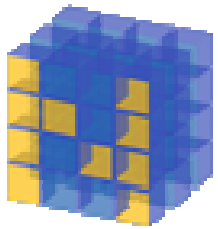
OpenRAVE

- http://openrave.org/docs/latest_stable/getting_started/#getting-started

Python, NumPy and SciPy

- http://www.python.org/

- http://www.numpy.org/
  - Efficient data structurs for numerical work
    - Matrix / vector manipulation (for our purpose)



- http://www.scipy.org/
  - Additional routines for scientific work
    - Integrals, differential equations, optimization

OpenRAVE
Programming – Code examples

NumPy

```
import numpy as np

#initialization vector
v1 = np.array([0,1,2,3,4])
V2 = np.arange(5)
#initialization matrix
A1 = np.mat([[1,2,3], [4,5,6]])
A2 = np.mat(`[1 2 3; 4 5 6]`)
A3 = np.array([[1,2,3], [4,5,6]])

#multiplication
V1 * v2
A1 * A2.T
A1.T
A1.I
```

OpenRAVE
Programming – Code examples

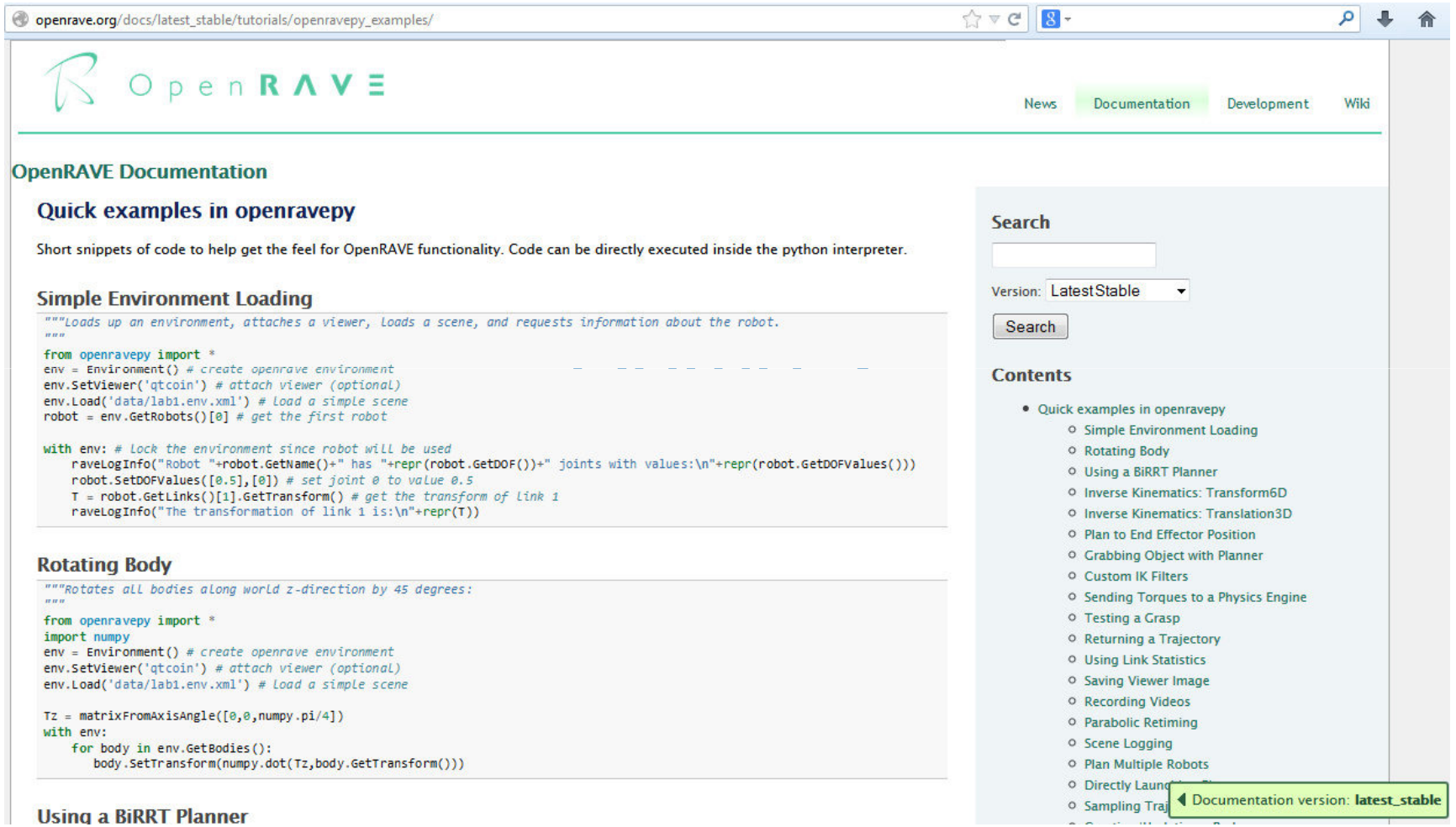
OpenRAVE

```
import openravepy as rave
import numpy as np

env = rave.Environment()
env.SetViewer('qtcoin')
env.Load('data/lab1.env.xml')

# your robot code ...
robot = env.GetRobots()[0]     # first robot
rodies = env.GetBodies()       # list of all bodies

robot[bodies].Set[Get]Transform[DOF, DOFValues,...]()
# for more information lookup the example on the website
```

OpenRAVE
Programming – Short demonstration

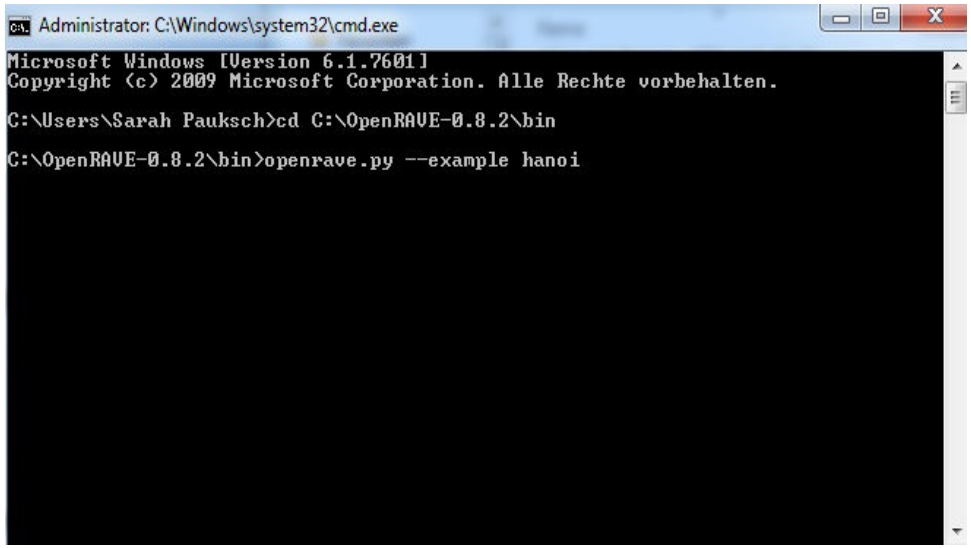
Demo 1

OpenRAVE
Programming – Short demonstration

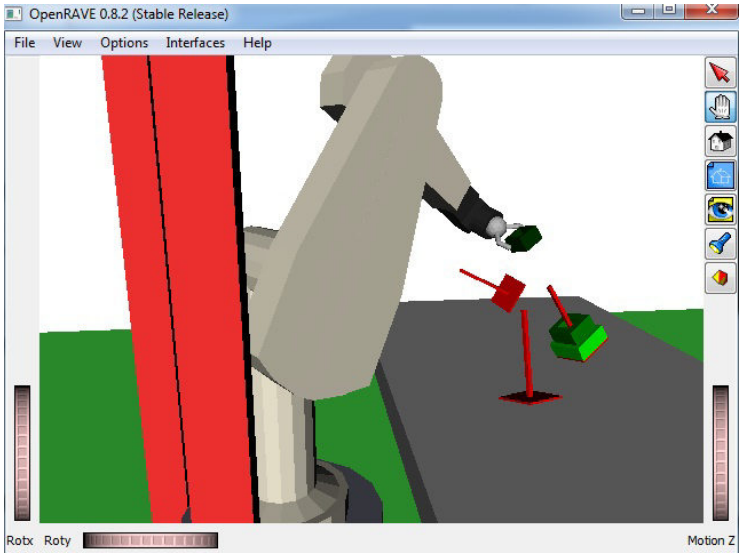


Screenshot openrave.org

Simple Example



CMD with python command

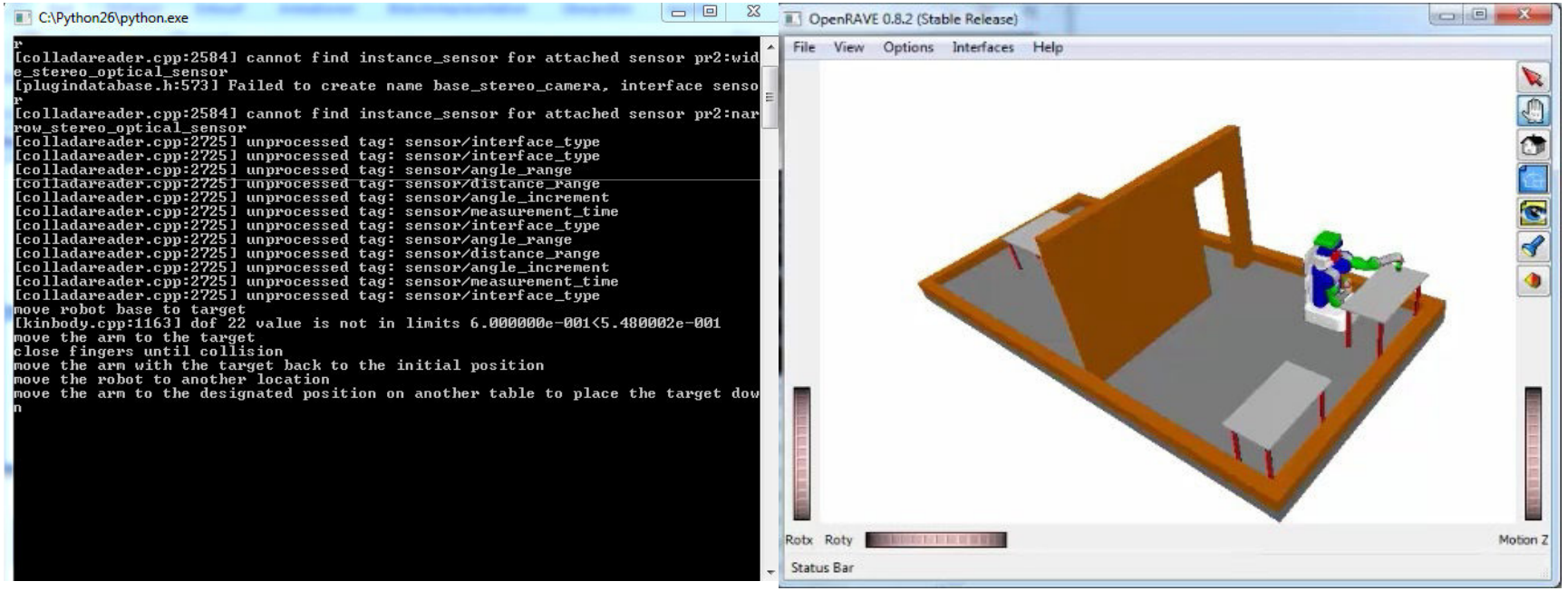


OpenRAVE 0.8.2 with example „Hanoi“

- Open example with CMD command or click on .py in examplefile
  → console and OpenRave will be open and present the process

Simple Example

- Look in examplecode
  - Right click to .py → “Edit with IDLE“



OpenRAVE 0.8.2 with example „simplemanipulation “

Literature

- [OpenRave]
  - http://www.openrave.org
  - http://openrave.org/docs/latest_stable/getting_started/#getting-started
  - http://www.programmingvision.com
- [Python]
  - www.python.org
  - http://www.numpy.org/
  - http://www.scipy.org/
- [Tools]
  - https://www.virtualbox.org/wiki/Downloads

Important files in Linux and Windows

Linux

- Examples:
  - /usr/lib/pythonX.X/dist-packages/openravepy/_openrave_0_8/
- Data:
  - /usr/share/openrave-0.8/

Windows

- Examples:
  - C:\OpenRAVE-0.8.2\Lib\site-packages\openravepy_openravepy_\examples
- Data:
  - C:\OpenRAVE-0.8.2\share\openrave-0.8