# *NeuroMan*

## *A Comprehensive Software System for Neuropsychological Experiments*

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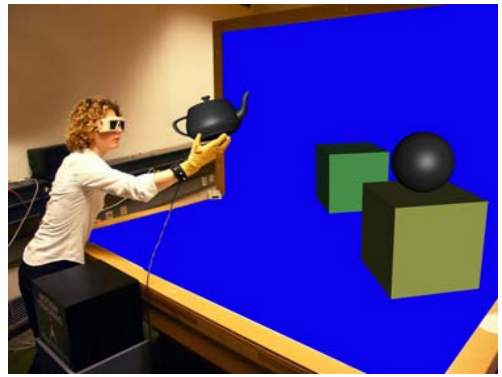
**RWTH Aachen University**

**Virtual Reality Center Aachen**

# Content

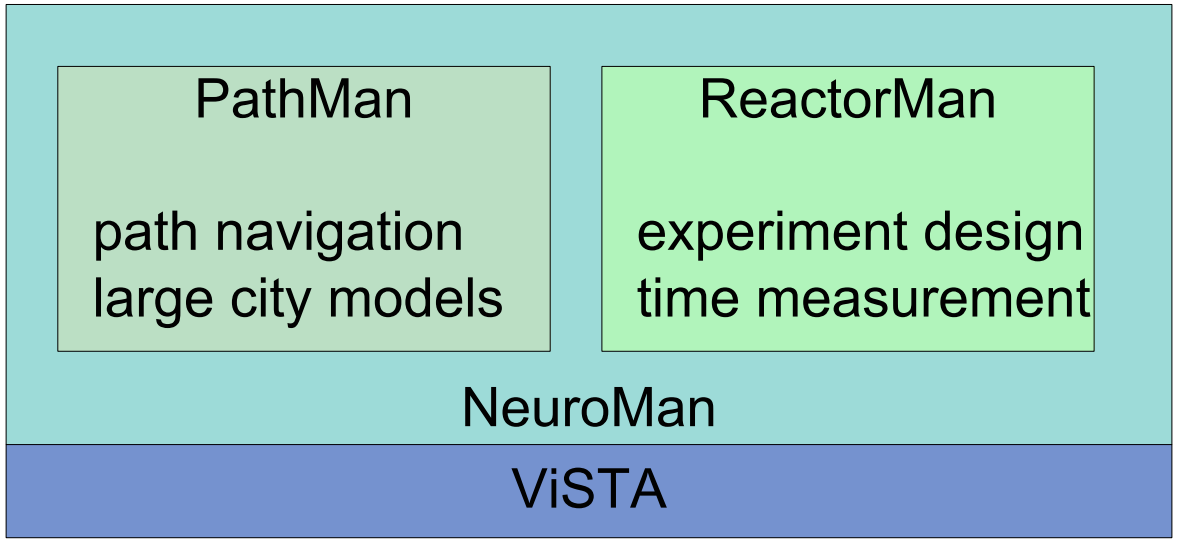
- NeuroMan Overview
  - System
  - Projects

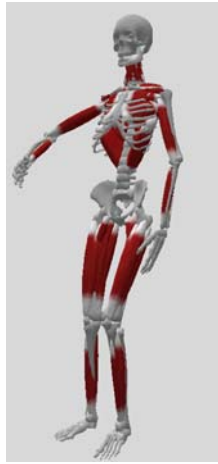


- Game Engine Features
  - Scripting
  - Input Devices
  - Data Logging

- Conclusion

# NeuroMan System



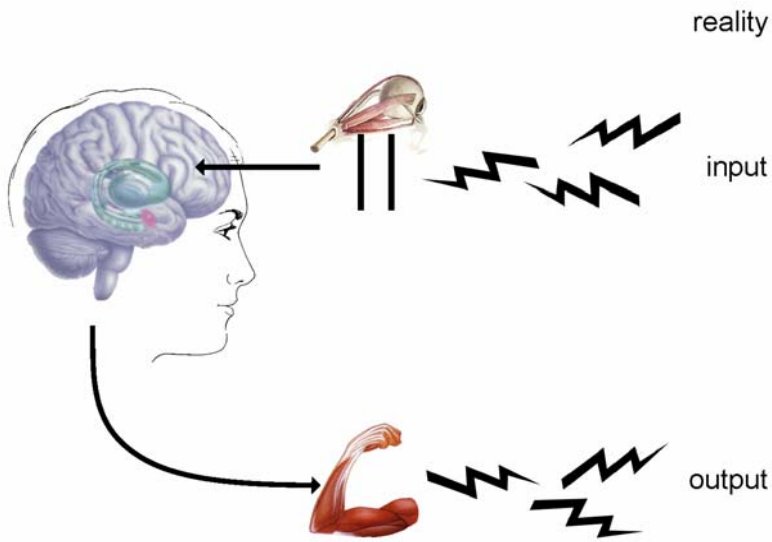



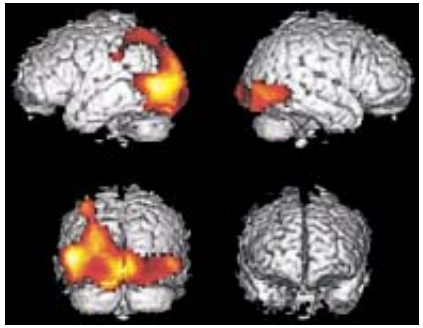
vZula

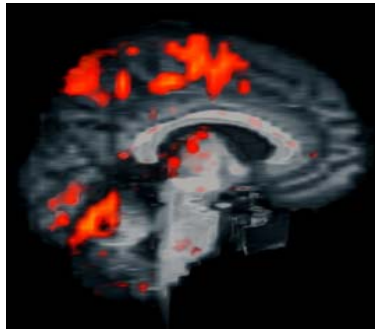
**Virtual humanoids**

# Neuropsychology

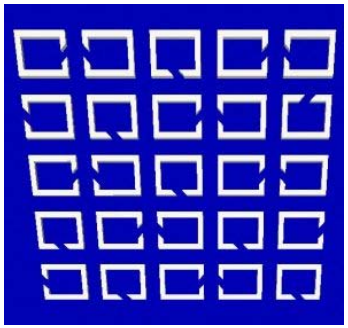
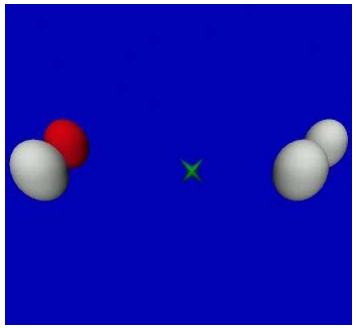
- Neurosciences
  - Exploration of cognitive functions of the human brain
  - Experiments
    - Present stimuli
    - Measure reaction
    - Analyse and reason



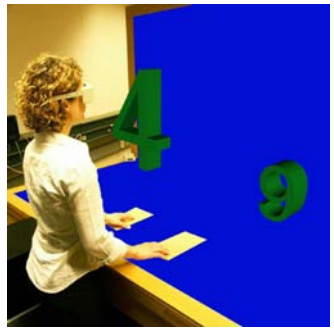




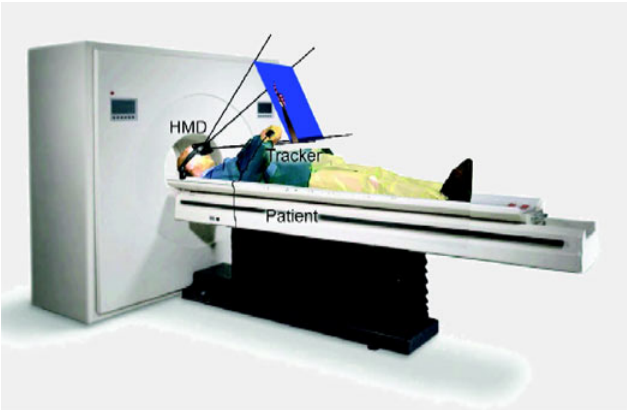
# Projects

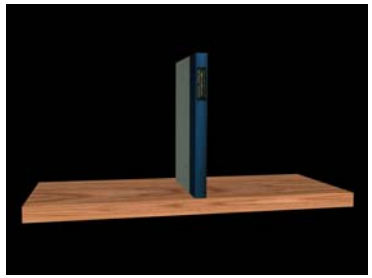
**Visuo-spatial attention**



**Mental number line**




**fMRI studies**



**Disorders of spatial representation**

# Game Engine

## Typical features:

| | |
|---|---|
| Real-time rendering (culling, fog, shadows) | ✓ WTK |
| Models (polygons, bézier curves) | ✓ VRML |
| Motion Control (kinematics, quaternions) | ✓ |
| Scripting/Storytelling | ✓ LUA |
| Collision detection (phases, bounding objects) | ➡ ODE |
| Physics (gravity, forces) | ➡ SOLID |
| Interaction (camera, 6 DOF) | ✓ ViSTA |
| Behaviour/AI (agents, sensing, learning) | ✗ |
| Sound | ➡ 3D |
| Networking (client-server) | ✓ Cluster |
| Tools | ✗ |

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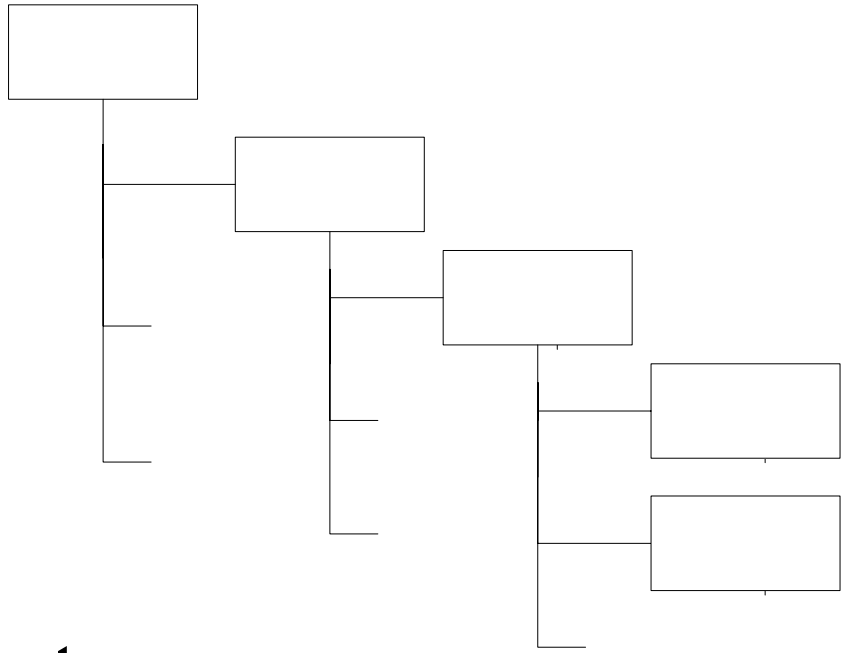
| Tools | ✗ | |
| Logging | ✓ | |

# Scripting/Storytelling

- Experiment
  - Session
  - Block
  - Trial
  - Scene
    - static (e.g., room)
    - dynamic (e.g., grasp)



- „Storyline“ with random elements
- Repeatable, re-usable modules

# Scripting/Storytelling II

- Scripting: LUA
  - General purpose, free language
  - Higher level concepts: ReactorMan language

```
trial_grasp = NewTrial()
  Comment( "Grasping" )
  DoScene( scene_grasp_object, 6000ms )
  RegisterEvent ("Hand", "prehension")
  WaitFor( keyb_anykey )
  IncorrectFeedback( scene_incorrect, 3000ms )
  TimeoutFeedback( scene_timeout, 3000ms )
```

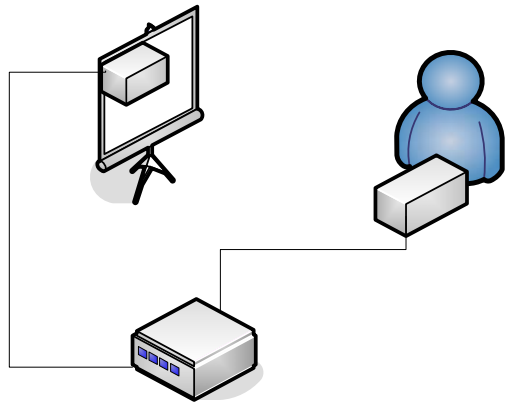
  - Full LUA vocabulary

```
function derive( pos, ori, button )
        -- Reset variables after finishing trial
        if( init_flag == 0 ) then
                init()
        end

        dx = (pos.x - pos_old.val.x) * epsilon
        dy = (pos.y - pos_old.val.y) * epsilon
        dz = (pos.z - pos_old.val.z) * epsilon
        return dx, dy, dz
```

# Input Devices

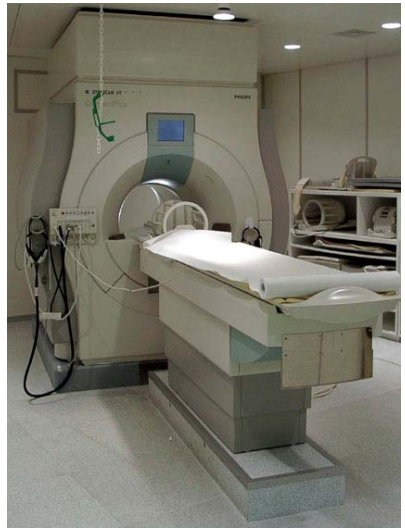
- Keyboard/Mouse/Joystick
- Tracking
  - User-centered projection
  - Motion capture
- Reaction devices
  - Accurate time measurement
  - External devices

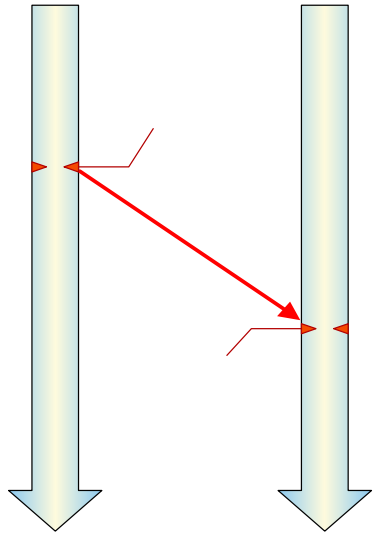


# Input devices II

- Data Glove
  - Simple gestures (LUA scripted)

- fMRI synchronization
  - Synchronize fMRI measurement and storyline
  - Special fiber hardware

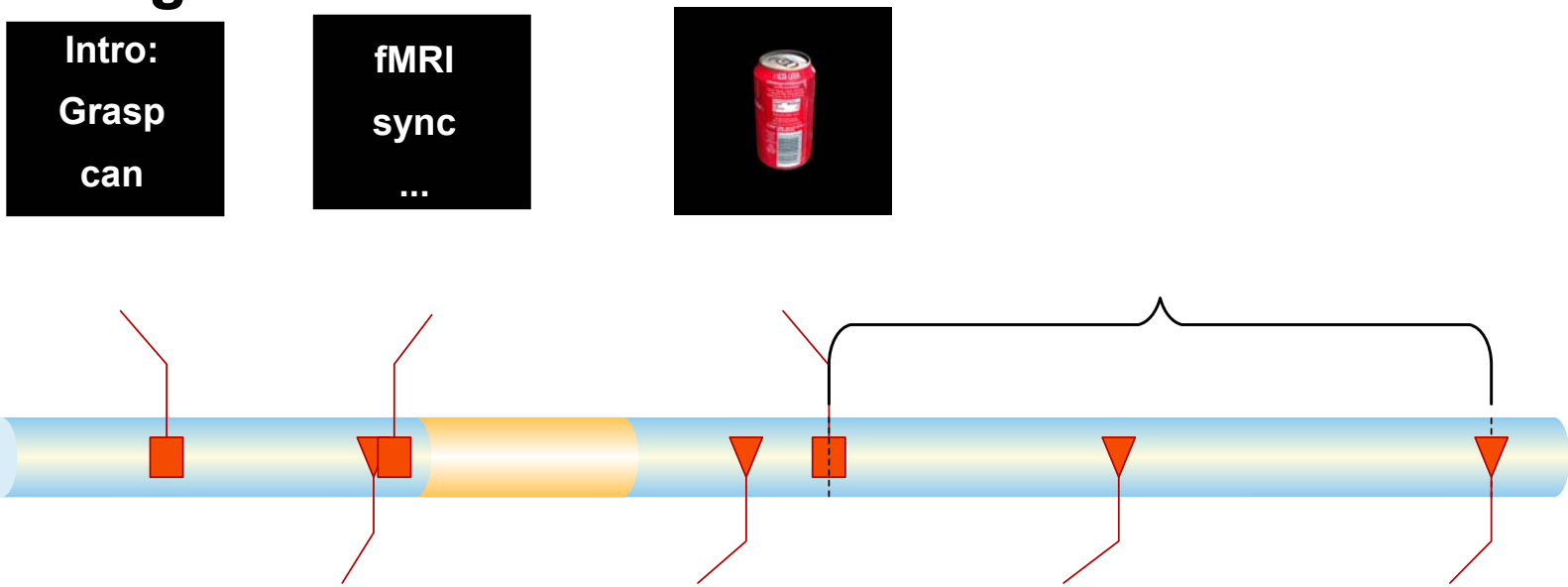




# Data Logging

- **Event Management:**

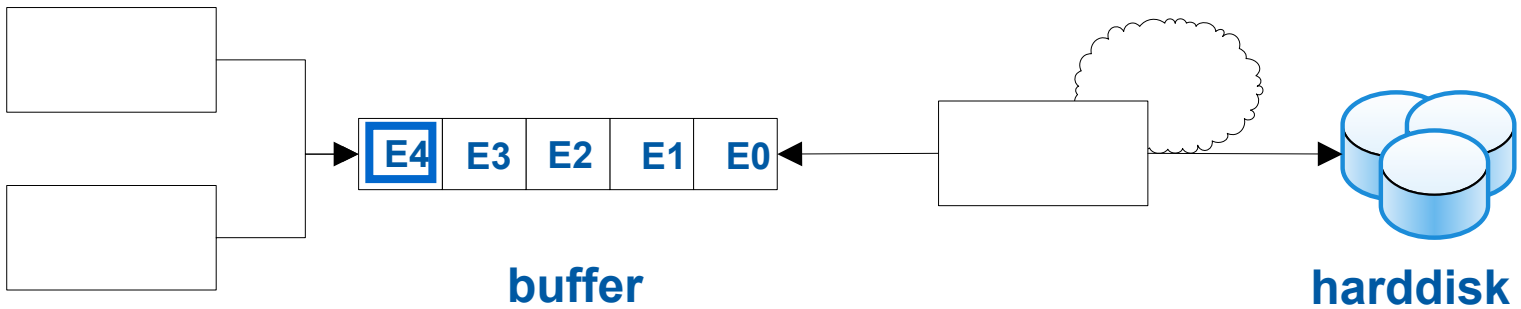
**Internal**

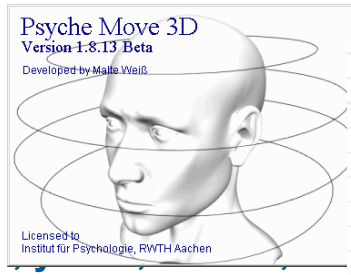


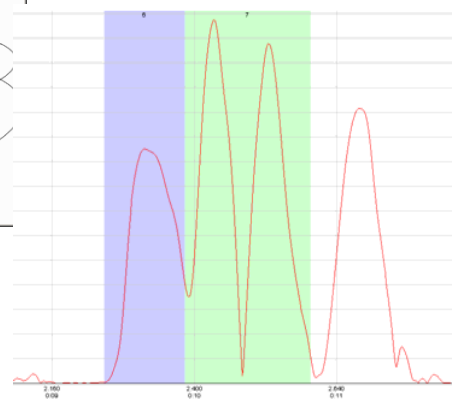

**External**

# Data Logging II

- Data Logging
  - Pipes and filters-architecture
  - Threads



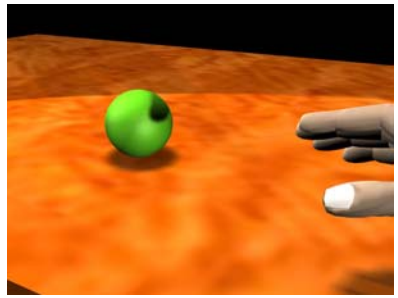



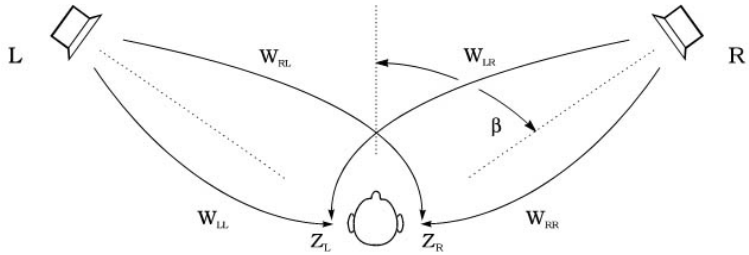
```
[HEADER]
Trajectories for proband male27 and device/object HAND
[DATA]
n, time    , ori_x        , ori_y   , ori_z   , ori_w        , x
0,2.95864,-2.5765e-10,2.39776,2.39776,6.12837e-10,0.19705,0.5756,0.36364,0
0,2.96903,-2.5765e-10,2.39776,2.39776,6.12837e-10,0.19705,0.5756,0.36364,0
0,3.00287,-2.5765e-10,2.39776,2.39776,6.12837e-10,0.19705,0.5756,0.36364,0
..........
```

# Future Work

- Grasping (Virtual Hand)



- Dynamics → ODE, SOLID
- Sound → binaural acoustics




- Moving objects/sound → animation, behaviour

# Conclusion

## *Neuropsychological Experiments*

- Game engine features

+ Virtual Reality

+ Accurate time measurement

+ Data logging

➢ System applied in various neuropsychological experiments

# Thank your for your attention!

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