USP - ICMC - SSC – LRM (Lab. de Robótica Móvel)
SSC 0712 (PRM) - 1o. Semestre 2015

Disciplina de Programação de Robôs Móveis SSC-0712

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Wiki ICMC: http://wiki.icmc.usp.br/index.php/SSC-712
ou http://wiki.icmc.usp.br/index.php/SSC-712-2015(fosorio)

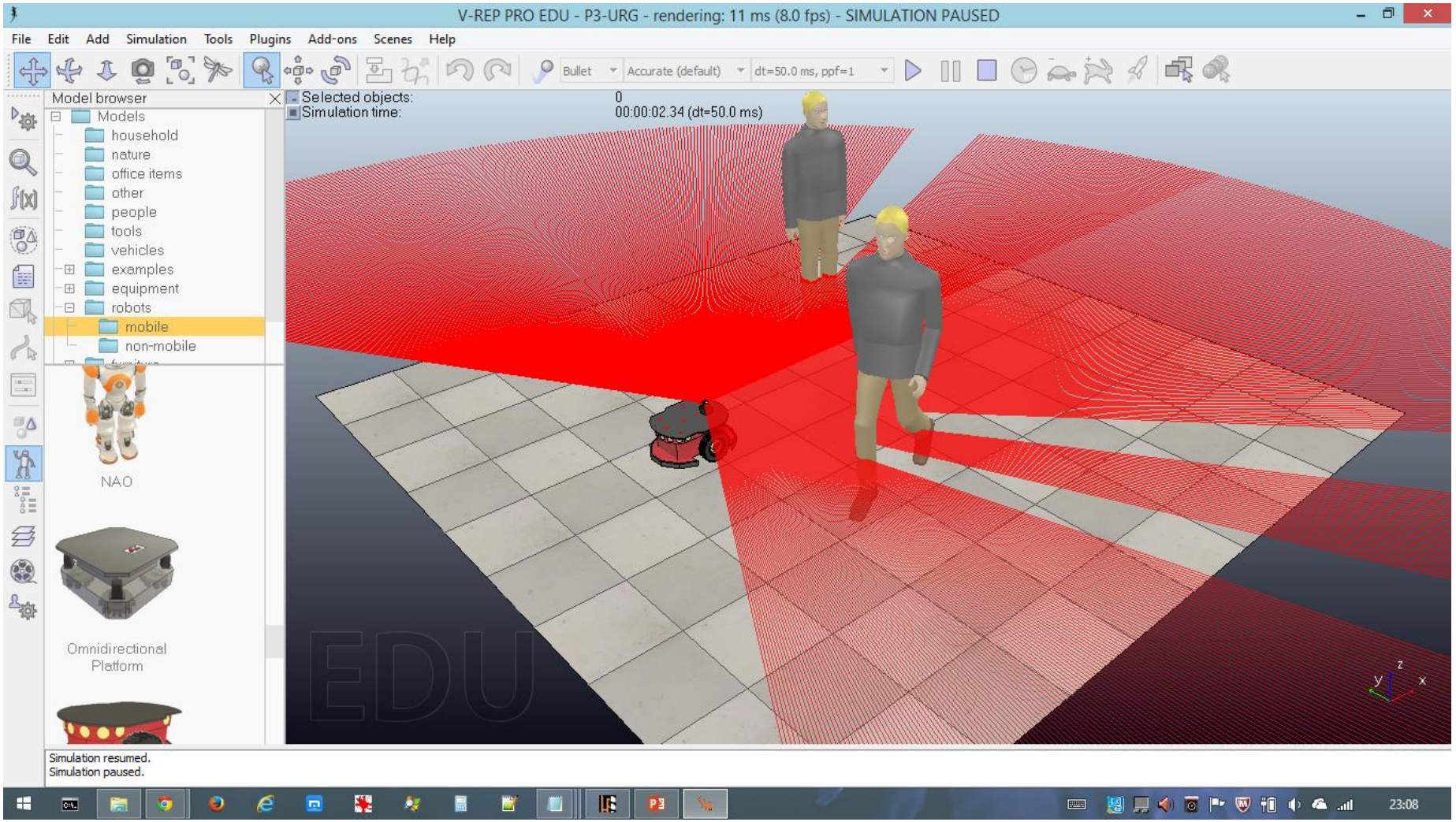
Aula VREP

Simulador V-REP

Software

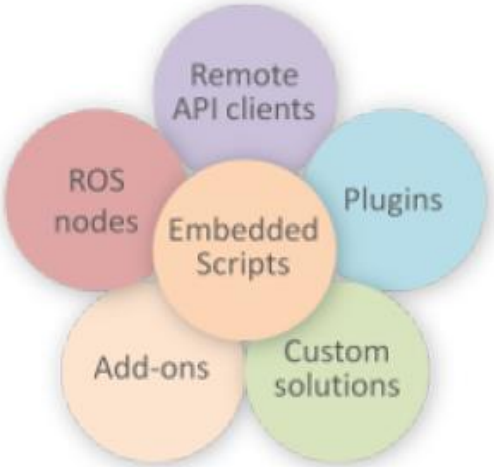
v-rep
virtual robot experimentation platform

http://www.coppeliarobotics.com/



Simulador V-REP

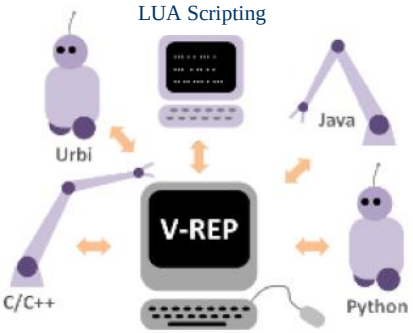
VREP is cross-platform, and allows the creation of portable, scalable and easy maintainable content: a single portable file can contain a fully functional model (or scene), including control code.
6 Programming Approaches



Regular API: 400 functions (C/C++ & Lua)
Remote API: 100 functions (C/C++, Python, Java, Matlab, Octave & Urbi).
ROS interface: 100 services, 30 publisher types, & 25 subscriber types.
Remote API

LUA
C / C++

Multiple Robot Models:
Mobile Robots
Humanoids
Manipulators
Aerial

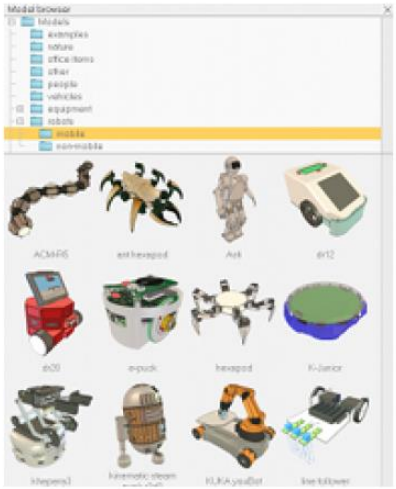


Dynamics/Physics

Bullet

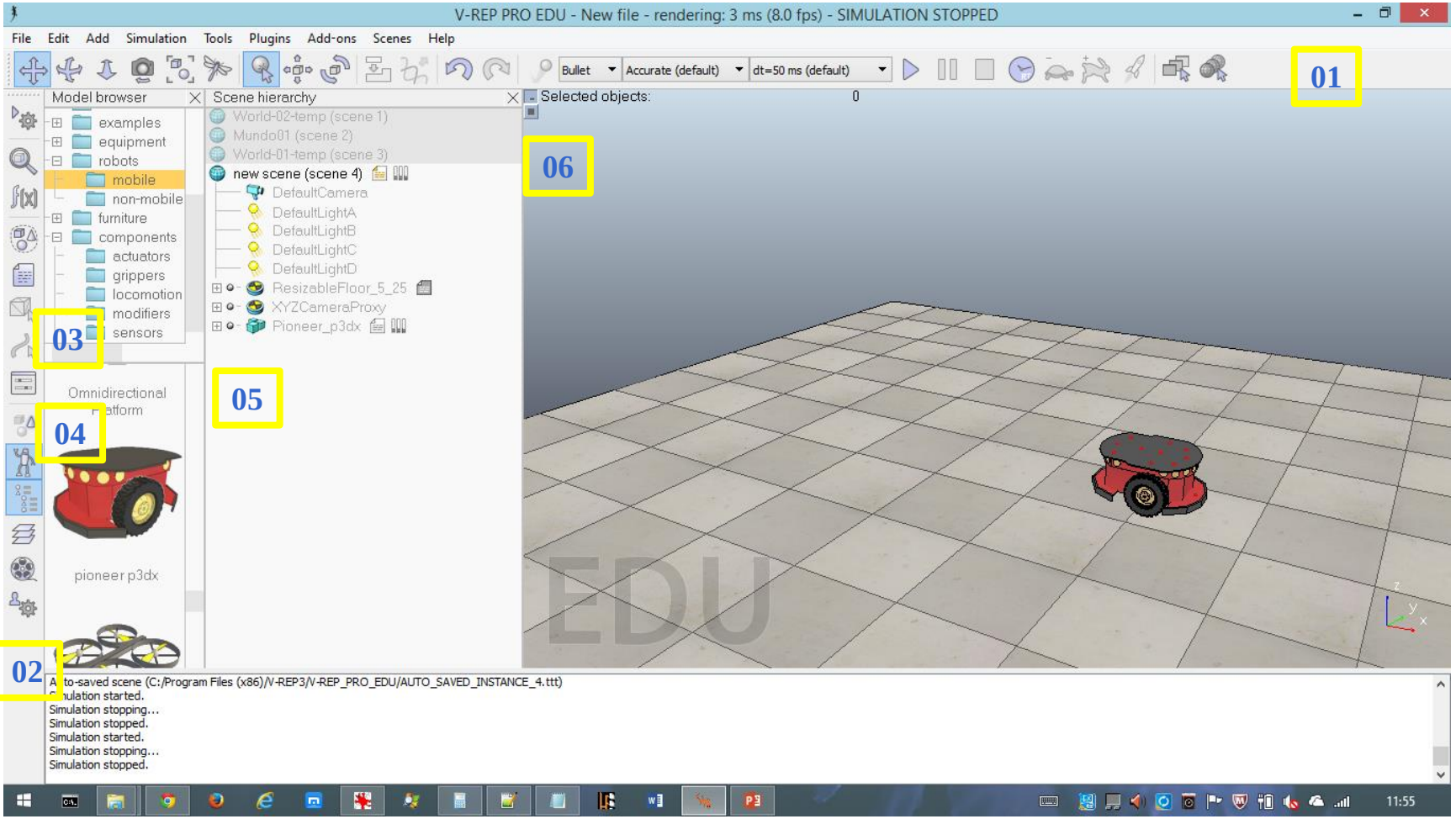
ODE

Vortex



Simulador V-REP

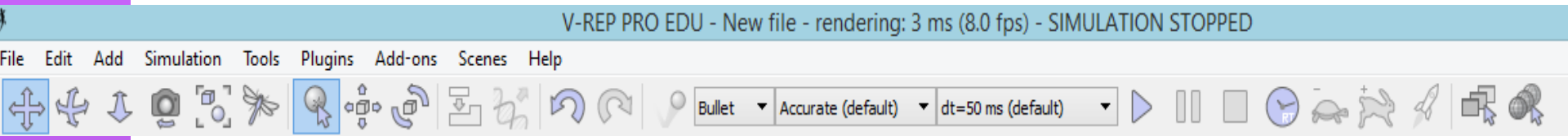
VREP Interface



01 – Barra Superior de Ferramentas
02 – Barra Lateral de Seleção de Interface
03 – Seleção de Modelos de Robôs, Elementos do Ambiente, Sensores, etc
04 – Seleção de Modelo Específico
05 – Detalhes do Elemento Selecionado (Scripts, Configuração, Descrição)
06 – Janela de Simulação Virtual 3D

Simulador V-REP

VREP Interface



Botões de controle da Câmera Virtual 3D: Posicionamento de Observação da Cena
Principais opções: Deslocar (Pan), Girar (Rotação ao Redor dos Elementos), Zoom (Avança/Recua)

Botões de controle do Objeto Virtual
Principais opções:
Selecionar Objeto, Mover o Objeto (pode indicar/selecionar os eixos: X, Y ou Z de deslocamento),
Girar o objeto (pode selecionar os eixos: X, Y ou Z de rotação)

Botões de controle da Simulação Virtual:
Play, Pause, Stop => Inicío/Fim Simulação
Acelerar ou ir mais devagar no "passo" de simulação

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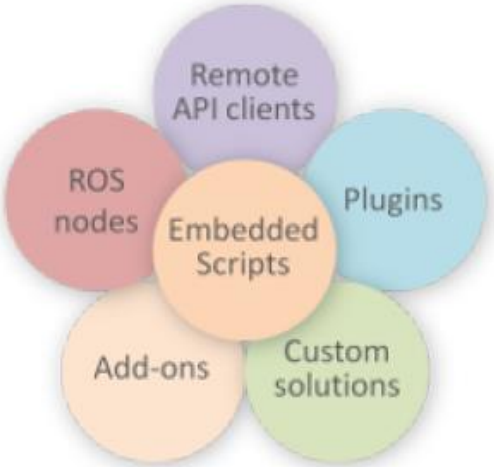

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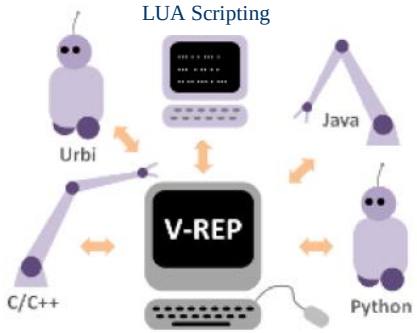

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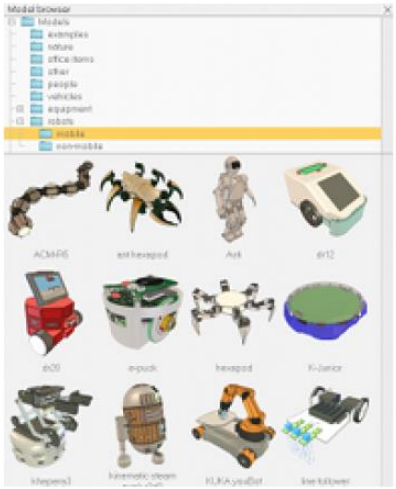
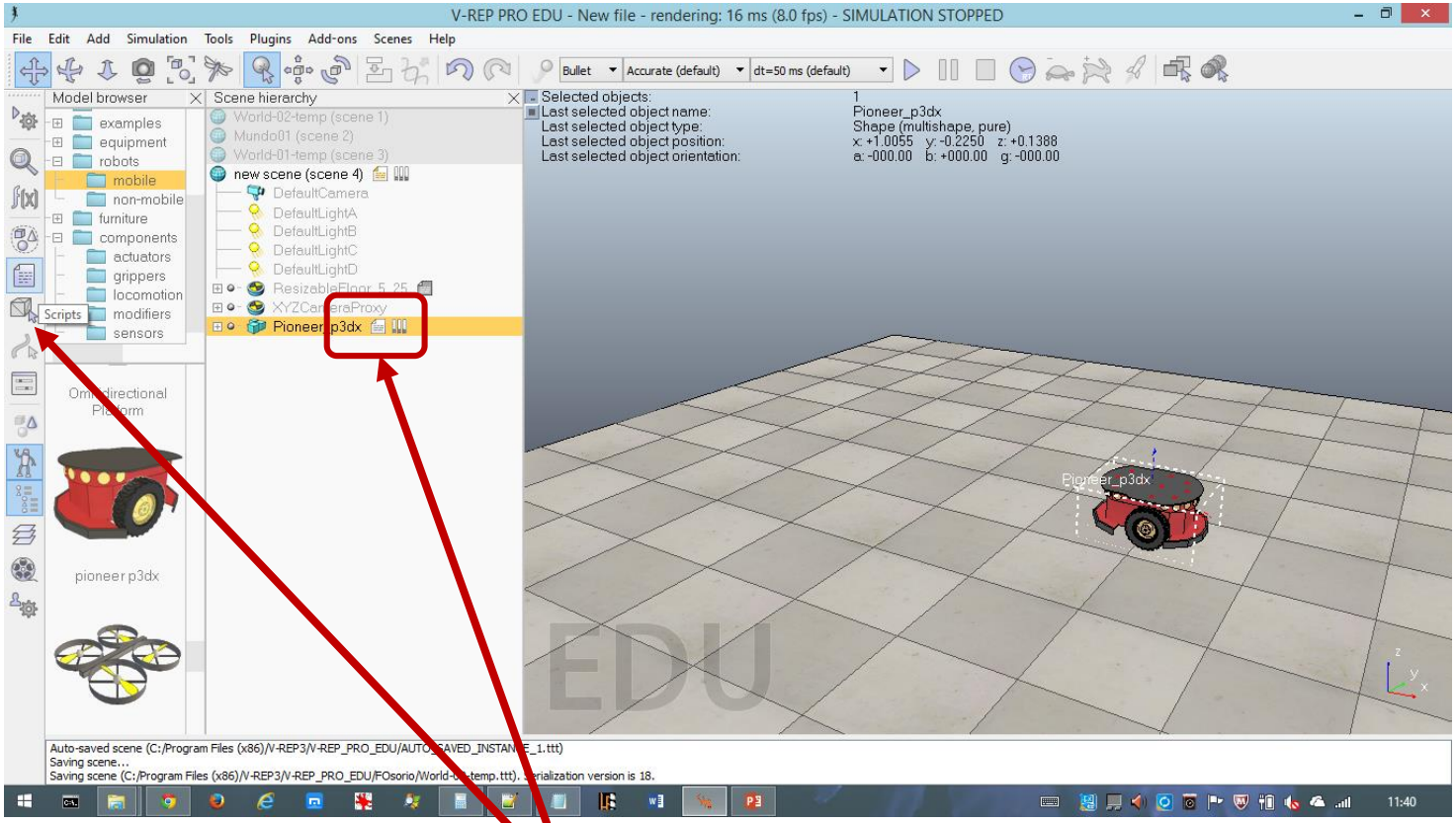
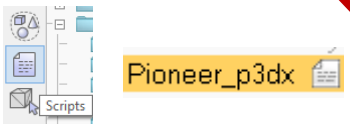


Simulador V-REP

V-REP: LUA Scripting

Esta será a forma de programação mais usada na disciplina para acessar os sensores, enviar comandos para os motores e realizar o controle inteligente ou tele-operado de robôs





Clicando no ícone do Script ou do Botão da Barra Lateral
Você tem acesso aos scripts de cada elemento da cena

Simulador V-REP

V-REP: LUA Scripting
Exemplo de SCRIPT LUA do Robô PIONEER

Non-threaded child script (Pioneer_p3dx)

```
1  -- This is a very simple EXAMPLE navigation program, which avoids obstacles using the Braite
2
3  if (sim_call_type==sim_childscriptcall_initialization) then
4      usensors={-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1,-1}
5      for i=1,16,1 do
6          usensors[i]=simGetObjectHandle("Pioneer_p3dx_ultrasonicSensor"..i)
7      end
8      motorLeft=simGetObjectHandle("Pioneer_p3dx_leftMotor")
9      motorRight=simGetObjectHandle("Pioneer_p3dx_rightMotor")
10     noDetectionDist=0.5
11     maxDetectionDist=0.2
12     detect={0,0,0,0,0,0,0,0,0,0,0,0,0,0,0,0}
13     braitenbergL={-0.2,-0.4,-0.6,-0.8,-1,-1.2,-1.4,-1.6, 0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0}
14     braitenbergR={-1.6,-1.4,-1.2,-1,-0.8,-0.6,-0.4,-0.2, 0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0}
15     v0=2
16 end
17
18 if (sim_call_type==sim_childscriptcall_cleanup) then
19
20 end
21
22 if (sim_call_type==sim_childscriptcall_actuation) then
23     for i=1,16,1 do
24         res,dist=simReadProximitySensor(usensors[i])
25         if (res>0) and (dist<noDetectionDist) then
26             if (dist<maxDetectionDist) then
27                 dist=maxDetectionDist
28             end
29             detect[i]=1-((dist-maxDetectionDist)/(noDetectionDist-maxDetectionDist))
30         else
31             detect[i]=0
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Simulador V-REP

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PARTE 1 do SCRITPT: Inicilização
sim_childscriptcall_initialization

Simulador V-REP

V-REP: LUA Scripting
Exemplo de SCRIPT LUA do Robô PIONEER

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27                 dist=maxDetectionDist
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30         else
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32         end
33     end
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```

PARTE 2 do SCRITPT: Execução
sim_childscriptcall_actuation

Simulador V-REP

V-REP: LUA Scripting
Exemplo de SCRIPT LUA do Robô PIONEER

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```

PARTE 3 do SCRITPT: Término **sim_childscriptcall_cleanup**

Simulador V-REP

V-REP: LUA Scripting - Exemplos de SCRIPTs LUA com DICAS para Implementar...

GRAVAÇÃO EM ARQUIVO

Na Atuação:

```
if (sim_call_type==sim_childscriptcall_actuation) then
…
    -- Abre o arquivo para adição de novo conteúdo (Append)
    fUsensors = io.open("usensors-log.log", "a")
    …
    -- Escrita (Exemplos)
    if (dist == nil) then
        fUsensors:write(tostring(dist))
    else
        fUsensors:write(string.format("%.4f\t", dist))
    end
        fUsensors:write("\n")
    fUsensors:write(string.format("%.2f ",vLeft))
    fUsensors:write(string.format("%.2f ",vRight))
    fUsensors:write(string.format("%.2f\n", os.clock()))
    …
    -- No final do script de actuation
    fUsensors:close()
end
```

Simulador V-REP

V-REP: LUA Scripting - Exemplos de SCRIPTs LUA com DICAS para Implementar...

GRAVAÇÃO EM ARQUIVO (ALTERNATIVO)

Na Inicialização:

```
if (sim_call_type==sim_childscriptcall_initialization) then
    -- Cria um novo arquivo para escrita(write)
     fDSensors = io.open("dados-sensor.log", "w")
     …
```

Na Execução:

```
if (sim_call_type==sim_childscriptcall_sensing) then
     …
     fDSensors:write(string.format("(%.4f;", angulo*180/math.pi))
     fDSensors:write(string.format("%.4f,) ", distancia))
     …
     fDSensors:write("\n")
     …
```

Na Finalização:

```
if (sim_call_type==sim_childscriptcall_cleanup) then
     fDSensors:close()
```

Simulador V-REP

V-REP: LUA Scripting - Exemplos de SCRIPTs LUA com DICAS para Implementar...

ESCRITA E LEITURA DE VARIÁVEIS ENTRE SCRIPTS (Globais)

Trocando dados entre o Script Pioneer x Script Hokuyo:

No Pioneer => adicionar as linhas que copiam as variáveis para um "signal" que pode depois ser lido em outro script

```
-- Cria Signals para enviar os dados
simSetFloatSignal("GVLeft",vLeft)
simSetFloatSignal("GVRight",vRight)
```

No Hokuyo => adicionar as linhas que lêm os dados salvos no outro script.

```
-- Recupera os dados enviados
valorlff=simGetFloatSignal("GVLeft")
valorrgt=simGetFloatSignal("GVRight")

-- Pode então usar como quiser, p.ex. exibindo na console
simAuxiliaryConsolePrint(myconsole,valorlft)
simAuxiliaryConsolePrint(myconsole,valorrgt)
```

INFORMAÇÕES SOBRE A DISCIPLINA

USP - Universidade de São Paulo - São Carlos, SP
ICMC - Instituto de Ciências Matemáticas e de Computação
SSC - Departamento de Sistemas de Computação

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Wiki ICMC: http://wiki.icmc.usp.br/index.php/SSC-712
> Programa, Material de Aulas, Critérios de Avaliação,
> Material de Apoio, Trabalhos Práticos