

Vehicles with Neuron like brains

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You are welcome to modify and use this code for non-commercial purposes providing you credit the origin (a web address is sufficient eg (<http://www.rdg.ac.uk/~shshawin/LN>)). If you make any clever changes and are happy for these to be published on the web please let me know so that I can update the program.

This program uses opengl and the glut libraries to simulate a number of 3D wheeled robots that seek out light sources. At a basic level the robots can be Braitenberg vehicles that is light seekers and light avoiders. But it is also possible to simulate predator prey interactions etc.

Download at (<https://github.com/WSHarwin/Neuron-vehicles>)

Versions compiled for Microsoft Windows are available at

<http://www.personal.reading.ac.uk/~shshawin/LN/braitenberg.html>

however these have had only very rudimentary testing.

1 COMPILING

1.1 COMPILING UNDER LINUX/G++

Program needs libglut3-dev

```
sudo apt-get install freeglut3-dev
```

This should also install opengl (mesa)

Compile with

```
g++ brait032.cpp nrWindow.cpp glutMaster.cpp glutWindow.cpp -L/usr/local/lib -lglut -lGL -lGLU
```

- source code in a zip file (http://braitenberg_v032.zip)

1.2 COMPILING UNDER MICROSOFT WINDOWS AND VISUALC++

Microsoft windows supports OpenGL but you will need to also install GLUT or Freeglut. These provide `glut.h`, `glut32.lib` as well as the runtime `Glut32.dll`. Freeglut provides in addition, `freeglut.h`, `freeglut_ext.h`, `freeglut_std.h`, `freeglut.lib`, and `freeglut.dll`.

To avoid compiling these from source I suggest using a site such as

<http://web.eecs.umich.edu/~sugih/courses/eecs487/glut-howto/> for glut

or <http://www.transmissionzero.co.uk/software/freeglut-devel/> for freeglut

There may be hints from <http://web.eecs.umich.edu/~sugih/courses/eecs487/glut-howto/>

1.2.1 header file:

Glut header files `*.h` will go in a directory GL try

```
C:\Program Files (x86)\Microsoft Visual Studio *\VC\include\GL\glut.h
```

The '*' matches your version of VS: 12.0 for VS2013, 11.0 for VS2012, 10.0 for VS2010, 9.0 for VS2008. You may have to create the include folder.

1.2.2 library file:

Library (`*.lib`) files will go somewhere like

```
C:\Program Files (x86)\Microsoft Visual Studio *\VC\lib\glut32.lib
```

If you want to build 64-bit apps, put the 64-bit library file in:

```
C:\Program Files (x86)\Microsoft Visual Studio *\VC\lib\amd64\glut32.lib
```

2 RUNNING UNDER LINUX

Should run from the command line or from a folder

3 RUNNING UNDER WINDOWS

To run you will need the Glut32.dll (or the freeglut.dll) either in the same directory as brait.exe or in the windows system directory.

4 OTHER OPERATING SYSTEMS, MAC OS, ANDROID. IOS ETC

It is probably possible to compile binaries for Mac OS, but the mobiles is likely to be more involved and the software is likely to need a redesign. I am happy to advise any adventurous individuals who wish to try.

5 USER INTERFACE

This is not a particularly friendly interface. This is a consequence of the decision so as to keep the code as simple as possible, and allow it to run on multiple platforms. OpenGL and Glut are the two libraries (other than standard C++) that are need to compile the code. GLU is also needed for gluLookAt and gluPerspective but could be replaced.

There are some commands available by right clicking on the playing field. A left click is used to select a vehicle or light (although a bug in the structure does not update the graphics immediately!).

Commands are either single letters, mainly lower case, or short commands in upper case. The mouse is needed for 's' (select) , 'm' (move) and 'a' (add).

bv.ini is a human readable file of parameters that can be changed on the fly. The first value to change is the Euler integration time 'Euler integrator' To find a working value, set up the environment with a M.Speculatrix

When you run the executable you should have the playing field. Zoom in and out with z/Z or o/O add a light with 'a' change it to M.Speculatrix by typing 'MS' start the simulation with the space-bar or 'Start world' by right clicking on the playing field. If it runs fast slow it down by reducing the Euler integrator time, and vice-versa. reload the bv.ini file with 'l'

Once the speed is reasonable you can change 'MS' into 'SS' 'AS' 'SP' 'AP' these always work on the selected object. Add lights by moving the mouse to where you want the light to be and typing 'a'

5.1 BUGS/TIPS

Having changed bv.ini and reloaded with 'l', you still need to reset a specific vehicle. Select that vehicle and type in the two letter command for the new values to take effect. This is (probably) a minor and fixable bug if anyone wants to contribute code.

5.2 UPPERCASE TWO LETTER (MOSTLY) COMMANDS

Following commands are used to change the vehicles nature

RL Reset to a light
AP Aggressive Phobe
SS Shy Seeker
SP Shy Phobe
AS Aggressive Seeker
DD Aggressive Seeker (DD)
DP Dumb Prey
BP Bright Prey
PR Predator
TV Test Vehicle
MS Machina Speculatrix
DUMP Dump a Matlab file

5.3 LOWERCASE (MOSTLY) SINGLE LETTER COMMANDS

A list of keyboard commands:

- mouse dependent commands
 - a - add a B.V. at the mouse position
 - s - select the nearest N.B.V.
 - m move N.B.V. to mouse
- general commands
 - < - Change selected N.C.V. to next vehicle in list
 - > - Change selected N.C.V. to previous vehicle in list

- e - erase the selected N.C.V.
- f - rotate c.c.w.
- g - rotate c.w.
- h - help
- i - information on the selected vehicle
- l - load information from the bv.ini file
- m - move the item selected to the mouse position
- n - set selector to next beast
- p - set selector to previous beast
- o zoom out (identical to 'z')
- O zoom in (identical to 'Z')
- q quit (esc will also quit)
- r - reset world to flat
- spacebar - start simulation
- t - tilt down
- v - tilt up
- x/X y/Y z/Z move camera in x,y,z

Menu commands: (Right mouse click)

Aerial view/Ground view Toggle labels Start and stop simulation Quit (was previously used to switch on lights, etc)

6 TIPS

In ground view (selected via the menu), lower the camera with Z/z to get the 'driver's' view.

7 INITIALISATION FILE

bv.ini is an editable file read in at the start and with the 'l' command.

7.1 BV.INI

Setting values in bv.ini

Time constants are $T=M/B$ linear and $I/Brot$, for rotations

The inertia of a solid disk is $Mr^2/2$, so assuming a mass of .5 and a dimension of .25, inertia would be around .000625

Predators that chase their prey tend to be heavier than their prey.

7.2 TESTBVINI

This is a helper program to ensure that values are being read correctly from bv.ini. The output should be compatible with Matlab or Octave commands so can be edited into a script (.m) file.

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