

The OpenGL (Jogl) framework in Bio7

With Bio7 1.2 custom 3d visualisations are possible in a specialized OpenGL panel which eases the development of 3d models.

In addition to the complete OpenGL syntax custom methods are available to easily load 3d models ,textures, custom shapes as well as libraries for geometrical measurements.

The drawback of this flexibility is that the user has to take care of certain circumstances which accompanies the direct use of OpenGL (e.g. if using the Fullscreen feature which retriggers the internal init method).

The Space view

The **Space view** is a new view in Bio7 1.2 which is enabled by default when the 3d perspective is opened. Aspects of this view can be controlled with the associated **Options Space** view which in addition is shown up by default in the 3d perspective. The **Quad3d** which was shown up in the previous versions of Bio7 is still available an can be enabled as a view in the view menu.

The Space view itself is an embedded GLPanel which visualizes OpenGL (Jogl) commands.

After activation of the Space view a quad, the x,y,z coordinates of the world and a grid in the x,y-plane are shown for orientation.

(the z-achsis is pointing to the user, **the OpenGL coordinate system is right-handed!**).

With the mouse the visible world can be rotated (“Arcball” interface) easily, moved left, right and moved forward or backwards.

Table 1: Interface Spatial view

Device	Event	Function
Left Mouse Button	Drag left, right,up,down	Rotation
Right Mouse Button	Drag left, right	Move forward, backwards
Middle Mouse Button	Drag left,right up, down	Move up,down, left, right

Table 2: Interface Walkthrough

Device	Event	Function
Left Mouse	Drag left, right, up, down	Rotation left, right, up, down
Key	PgUp, PgDn	Move up, down
Key	Arrow left,right	Rotation left, right
Key	Arrow up, down	Move forward, backwards

Custom OpenGL commands can be written in the Java editor as regular Java code and after compilation enabled in the **Options Space** view.

With the the help of the Bio7 wizard a new OpenGL file can easily be created. Two parametrized methods (ecomain,setup) will be created which make the gl (glu, glut) context available to draw custom shapes and develop models in 3-dimensional space.

Table 3: The default methods

```
public void setup(GL gl,GLU glu,GLUT glut) {  
// Please enter your Java OpenGL setup code here  
}  
public void ecomain(GL gl,GLU glu,GLUT glut) {  
// Please enter your Java OpenGL code here  
}
```

After the compilation the execution must be enabled in the “Options Space” **Time** panel. Also the setup method can be triggered here. The execution is separated from the normal execution of Bio7 to guarantee that the different thread are not mixed together which could result in an application crash. Furthermore the use of the animation timer guarantees a smooth animation of the developed model.

It is very important not to trigger OpenGL methods from the regular execution thread of Bio7 that's why these custom methods are available to access the full power of OpenGL(Jogl).

If enabled the ecomain method is triggered by means of the OpenGL timer and the default frame rate (as fast a the Graphics card allow it). The speed of the execution of the ecomain method or the change of certain variables can be controlled by means of a custom method *canStep()* which switches a boolean value in dependence of a slider which is also available in the Time panel. Both frame rates, the regular execution speed (fps) and the speed of the triggered step (step fps) method can be visualized in the “Space view”. In addition a pause can be enabled which switches the boolean of the *canStep()* method to false.

If you want to control the speed of a simulation you can use the canStep() method to change values of variables (e.g. spatial coordinates) and hold them with the pause.

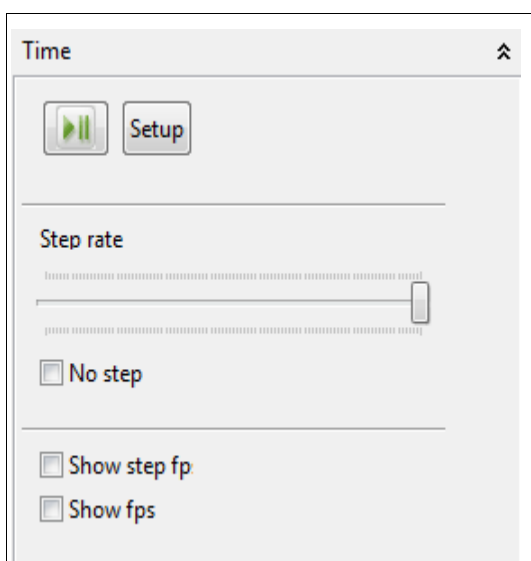


Illustration 1: The time control

In the **Space** panel of the Options view several adjustments can be made for the default components of the Space view. The **Fullscreen settings** allow to adjust the screen resolution etc. before switching to the full screen mode (if available!).

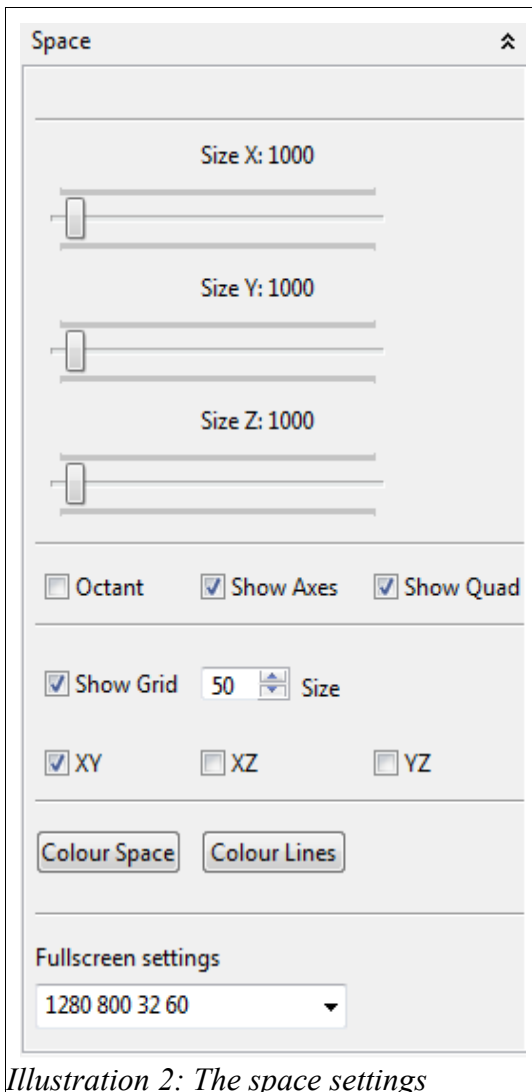


Illustration 2: The space settings

In the **Model** panel a default *.obj model can be created for a custom environment in a simulation or a visualisation of an 3d model. The *.obj model can be created e.g. with blender and can be textured, too. Please consider the size of the of the texture if you create a model with a texture which has to have a power of two size (e.g. 256,256, 512*512, 1024,1024).

By default methods are available to scale and position the model in the Space view. These settings can be stored with the **Store** button (only integers will be stored!)

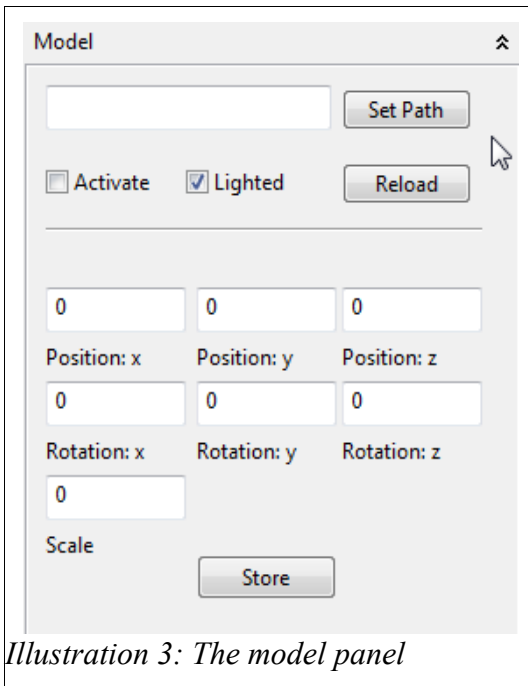


Illustration 3: The model panel

In the **Texture** view a default textured plane can be created which can be static or animated dynamically. Several options are available. By default the texture plane is as big as the size of the image. The **Change** button is responsible to change to the selected texture source..

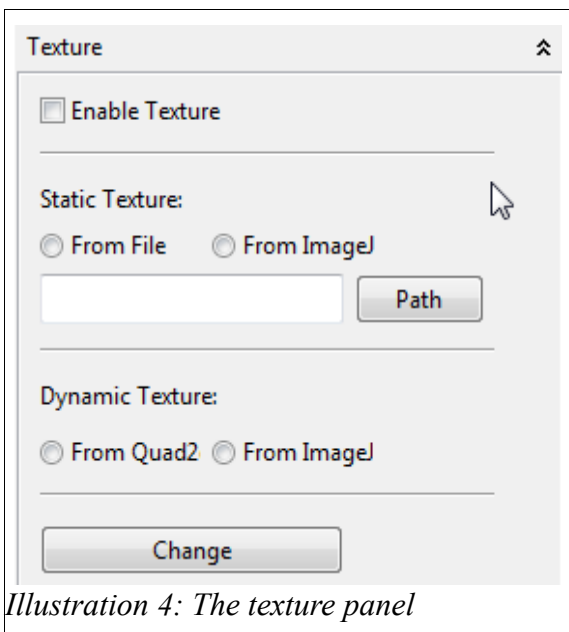


Illustration 4: The texture panel

The **Height Map** panel can visualize a simple height map with height values of an enabled greyscale (8-bit, 16-bit, 32-bit) ImageJ image. The pixel values of the image determine the height of the height map. Some additional parameter control the resolution of the height map and a multiplying factor for the height. By default the height map is textured with the default selected image in the Texture panel (static or dynamic). Since the height map depends on an ImageJ image the image can be edited with ImageJ methods. Additionally an *.hgt importer script is shipped with Bio7 1.2 which creates a 32-bit image as an height map with correct height values in ImageJ.

With the **Camera** panel several aspects of the Space view perspective can be controlled. A **Walkthrough** option enables a classical walk through perspective to walk through a virtual world or position a camera to a custom position. If enabled the plane is rotated to a position

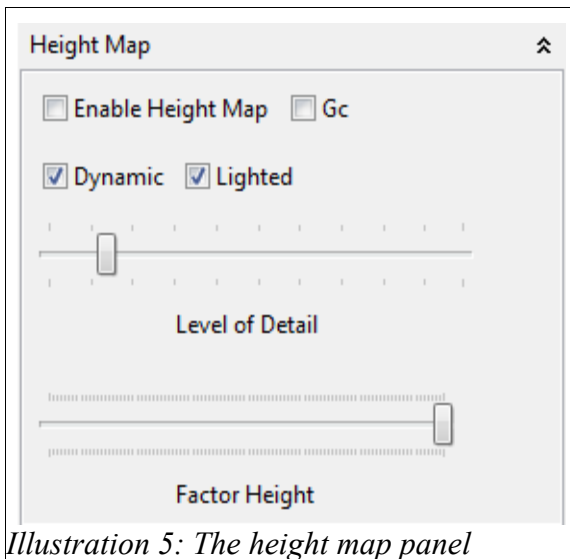


Illustration 5: The height map panel

that the z-direction is pointing up. The walk directions (rotations up and down) can be controlled with the mouse and the arrow keys (see table 2). The camera in this mode will always stay above the plane. This is not the case if the **Flythrough** option is additionally selected. Then the up and down rotation of the camera changes the height position and the camera can also be moved below the plane or to negative height values.

If the **Custom camera** is selected the camera can be positioned programmatically and only shows the camera perspective if defined programmatically (and compiled!).

With the **Split View** option an overview can be enabled in the low left of the Space view.

In the text fields the **Position** of the camera and the **LookAt** coordinates of the camera can be entered (double values possible) and stored with the **Store** button.

The last option enables an experimental **Stereo** renderer of the Space view for an anaglyph view of the Space.

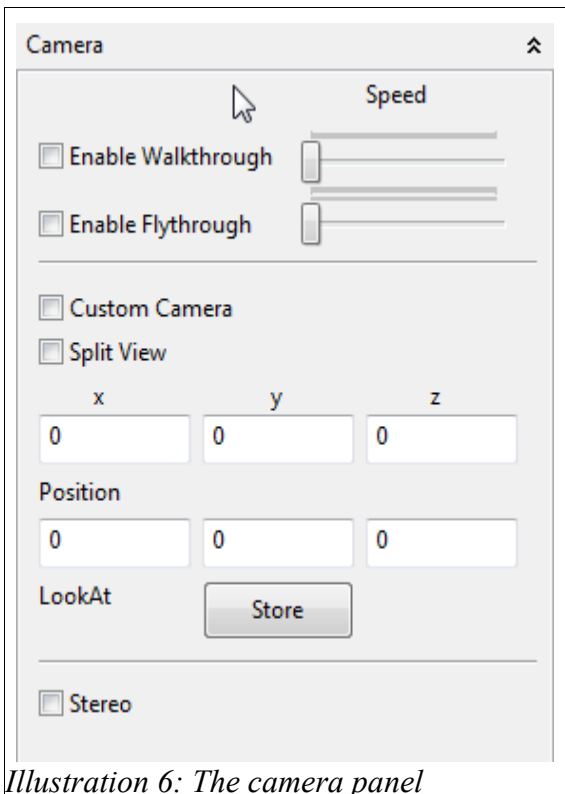


Illustration 6: The camera panel

The **Light** panel controls the light of the Spatial view. Four different light source can be enabled and positioned with the text fields. Please consider that the lights have a visible effect if more than one normal is defined for the surface (e.g height map, 3d models). If the **Local light** option is enabled(recommended!) the enabled lights are rotating with the world view.

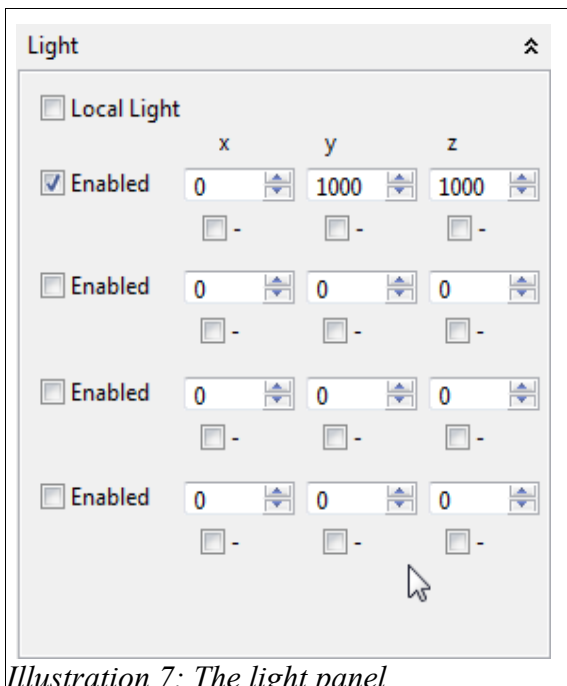


Illustration 7: The light panel

In the **Image** panel a screenshot from the current Space view can be transferred as an image to ImageJ. Furthermore it is possible to render a selectable amount of frames to ImageJ as an image stack which then can be saved as an *.avi file or an animated *.gif file.

The size of the visible Space view determines the size of the images and the stack. A resize of the Space view automatically stops an active rendering to a stack.

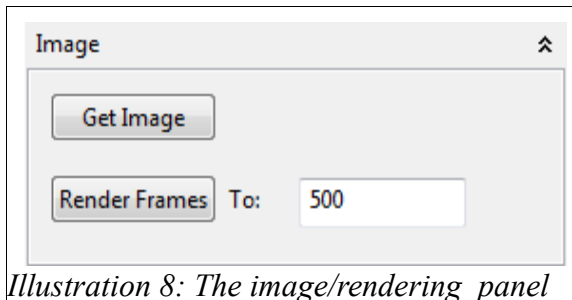


Illustration 8: The image/rendering panel

Fullscreen mode

If **Fullscreen** mode is supported the Fullscreen mode can be enabled with the **F2** key and quitted with the **Escape** key.

This use of the fullscreen mode will trigger the setup method so it is important that certain objects are recreated in the setup method for the correct GL context (avoids a crash of the whole application!!!).

TextRenderer objects, Texture objects and *.obj models should be created in the setup method with the correct gl context.

Several example are available and demonstrate the general use of OpenGL inside of Bio7. Since OpenGL is single-threaded the Bio7 ecomain method is executed from the internal OpenGL **display** method. The Bio7 setup method is triggered from the internal OpenGL **init** method.

For a pain free use of OpenGL inside of Bio7:

1. Please do not call an OpenGL method from a different thread.
2. Generally create the following objects and models in the setup method:
TextRenderer objects, Texture objects and *.obj models

This ensures that the created objects in Fullscreen mode will be recreated with the correct gl context. For more information about this read the Jogl User's guide at:

<https://jogl.dev.java.net/>

About Jogl in general the book of Andrew Davison:

Pro Java 6 3D Game Development ISBN: 1590598172

<http://www.apress.com/book/bookDisplay.html?bID=10256>

Web Site for the book: <http://fivedots.coe.psu.ac.th/~ad/jg2>

(The *.obj loader source and part of walk through ideas are from this book which is highly recommended for an introduction of Jogl).

New R methods

The execution of R scripts under Windows is now in the most parts stable and variables can be printed, too.

Furthermore errors are indicated after the file has been interpreted.

New R methods are available and the menu has been extended with several methods.

*.Rdata files can now be dragged on the toolbar of Bio7 (or the console) which will start the Rserve application and load the data file automatically.

Windows Vista Notes:

It is important that you have writing permissions (e.g. for the “Start RGui with Workspace”) action to directories defined in the preferences else data can not be loaded and (no error message occurs!).

One possibility is to start Bio7 as Administrator (Right-click on the *.exe of Bio7).

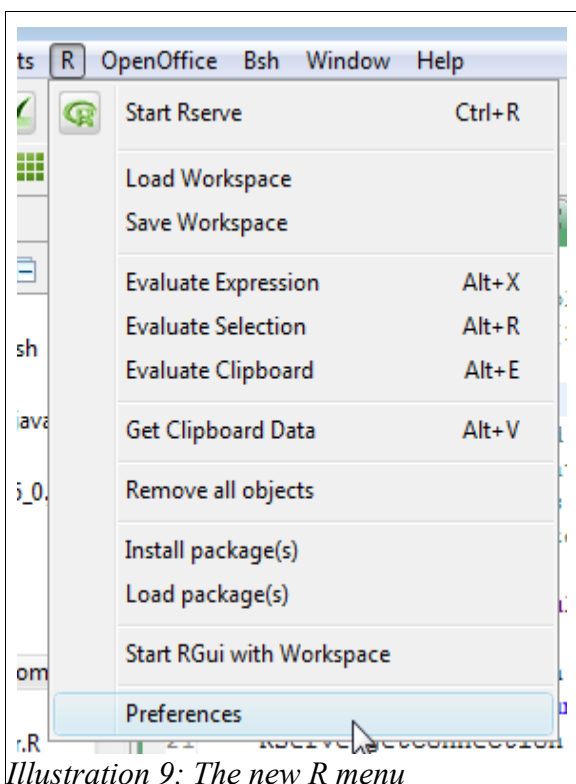


Illustration 9: The new R menu

New actions:

The **Evaluate Clipboard** action evaluates R scripts which were transferred before to the clipboard.

Get Clipboard Data will transfer data from the clipboard to the workspace of R and is stored in a dataframe “clip”.

The **Install package(s)** action will open a dialog to install packages from the available repository of R.

The **Load package(s)** action will open a dialog to select and load an already installed library.

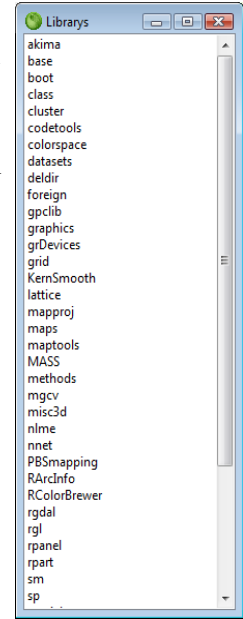


The dialog to install packages from the CRAN server fetches a list from available packages if the **Get List** action has been invoked. The package in the list which should be installed has to be selected and the **Install Selected** action has to be invoked to install the package to a selected location. A separate tab item for (thematic) packages for spatial analysis is also available.

If a package in this list is selected some information will be displayed as a tool tip.

A right-click on the selected package opens the website of the package by means of the standard internet browser.

The **Librarys** dialog shows the installed packages which can be loaded with a double-click of the mouse device.



The expression dialog has been redesigned and now orders the command in different tab items. A **double-click** with the mouse device transfers the command to the text field. A **right-click** transfers the selected command to an opened R-editor (if available!).

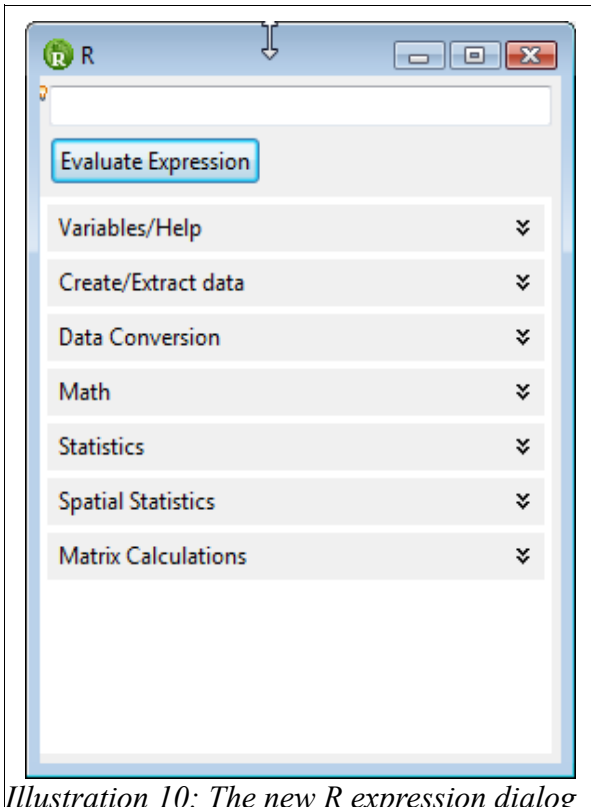


Illustration 10: The new R expression dialog

If the action “Preferences” has been selected an extra preferences dialog pops up with several new options (The preferences are also available under the regular prefs. of Bio7). The preferences of R inside of Bio7 are extended to select a package server for R and also an install location for external packages .

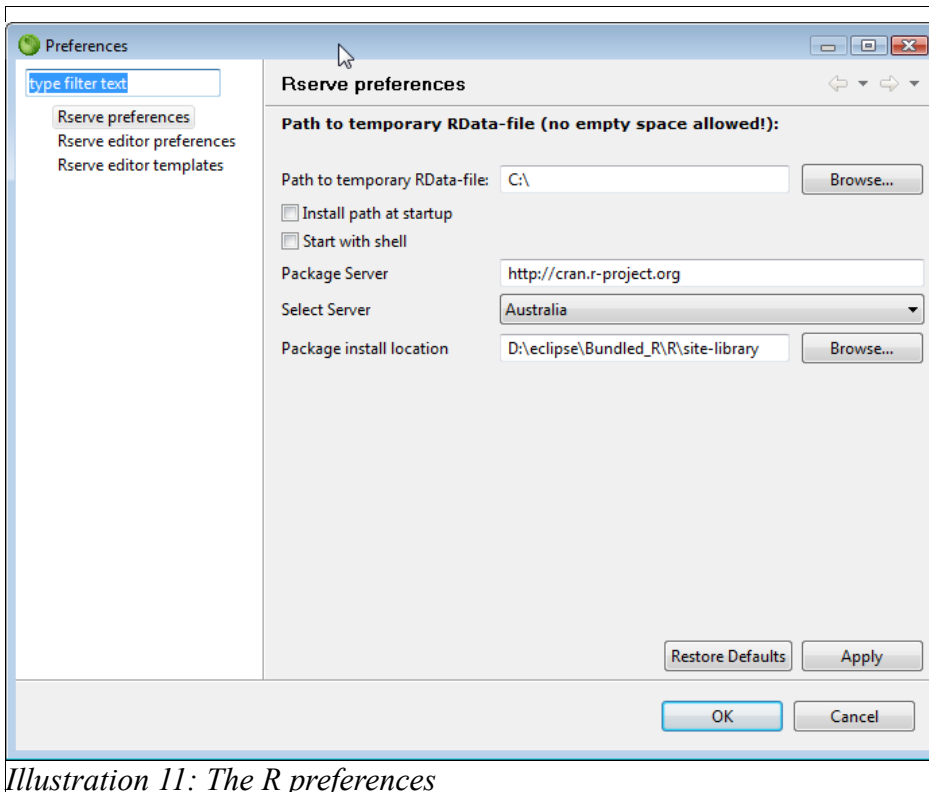


Illustration 11: The R preferences

Important:

Because Windows Vista is very sensitive to user rights etc. the package installation was reorganized for installable add-on packages inside of Bio7. The default add-on package location is now:

Rhome/site-library

At this location inside of Bio7 the packages will be installed by default (if not changed!).

When starting the Rgui by means of Bio7 the default path to available packages is determined over the registry (Rhome with the **Rhome/etc/.Rprofile** file).

To synchronize the package location (Bio7 and Rgui) please start Bio7 with the enabled **Install path at startup** once to set the registry path to the bundled R location.

By default this option is disabled not to harm any default user installation of R.

Images transfer with R and ImageJ

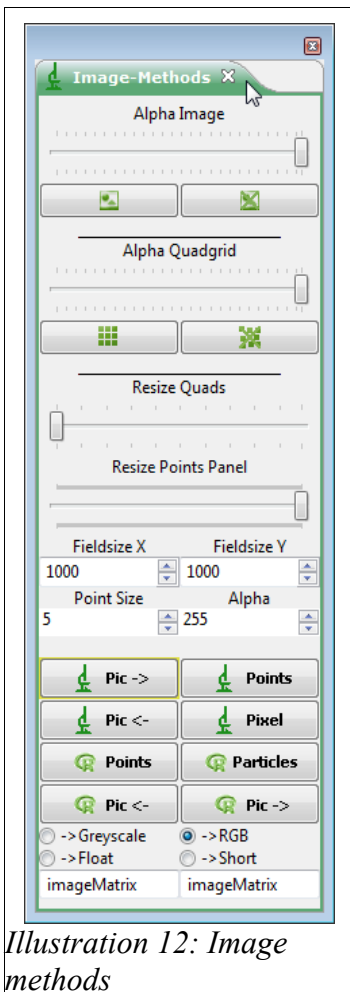


Illustration 12: Image methods

The **Image-Methods** view has been extended with methods to easily send images to R or to create images from R. If a transfer to R action has been triggered a dialog will ask the user if a matrix should be created from the image data. The data or (if selected) matrix will be named after the text in the left text field. If no matrix has been selected a list will be created with name **imageData**. If only data should be transferred another option is available to transfer this data as integers (default is double!). Right double-click on the button will switch between the two data transfer options. For a creation of an image from R an image matrix has to be available in the workspace of R. The text of the right text field has to be named after the matrix to transfer the data and create an image in ImageJ. It is also important to select the right data type (instance of ImageProcessor) from the radio buttons to create different types of images appropriate for the R data.