Chapter 4

User Interface

This manual is available on-line at the URL

`http://www.geom.umn.edu/locate/pisces/`

The on-line version may be more current, and may contain features not contained in the printed version. For example an the on-line version contains an interactive interface to Pisces via the World-Wide Web.

4.1 User Interface

The Pisces Main Panel.

The easiest way to control Pisces is through its graphical user interface. Upon first starting Pisces, you are presented with its *main panel*. From this panel, you may select:

File Menu

These options control the saving and loading of data, and the quitting of Pisces.

Output Menu

These options control where Pisces sends data.

- View Window: Open a new two-dimensional canvas window and send data to it. This option is available to every user through the Tcl/Tk toolkit.
- Geomview: Send data to a Geomview session (invoking Geomview if necessary). This option is only available for users with UNIX workstations (or running linux on a PC) who have installed Geomview.
- Postscript File: Send data to a postscript file, in preparation for sending the file to a postscript-compatible printer.
- File: Send data to an ascii file in Geomview format.
- Standard Output: Send data directly to a the standard output in Geomview format.
- Erase All Graphics: Delete all objects from the graphics buffer.

Algorithm Menu

Which algorithm should Pisces use to compute a level set?

- Adaptive Grid Algorithm: Computes a curve in the plane.
- Box Algorithm: Computes a curve in the plane or a surface in 3-space.
- Geisow's Algorithm: Computes an *algebraic* curve in the plane. That is, the model must be a polynomial function of two variables.
- Simple Algorithm: Computes a curve in the plane.
- Predictor-Corrector Algorithm: Computes a curve in arbitrary dimensions.
- Recursive Surface Algorithm: Computes an implicitly-defined surface in 3-space.

Settings Menu

These options control parameters that determine how Pisces computes and displays implicitly-defined curves and surfaces.

- Model: Control the domain variables, the parameters, and the range variables for the currently selected model.
- Output: Control the way that Pisces displays data.
- Jacobian: Set parameters that determine how Pisces computes derivatives and invokes Newton's method.
- Derived Model: From a single coded model, the user may derive new models and compute the level sets of these functions.
- Geomview: If Geomview is being used to view level sets, the user may decide which coordinates to send to Geomview.

Utilities Menu

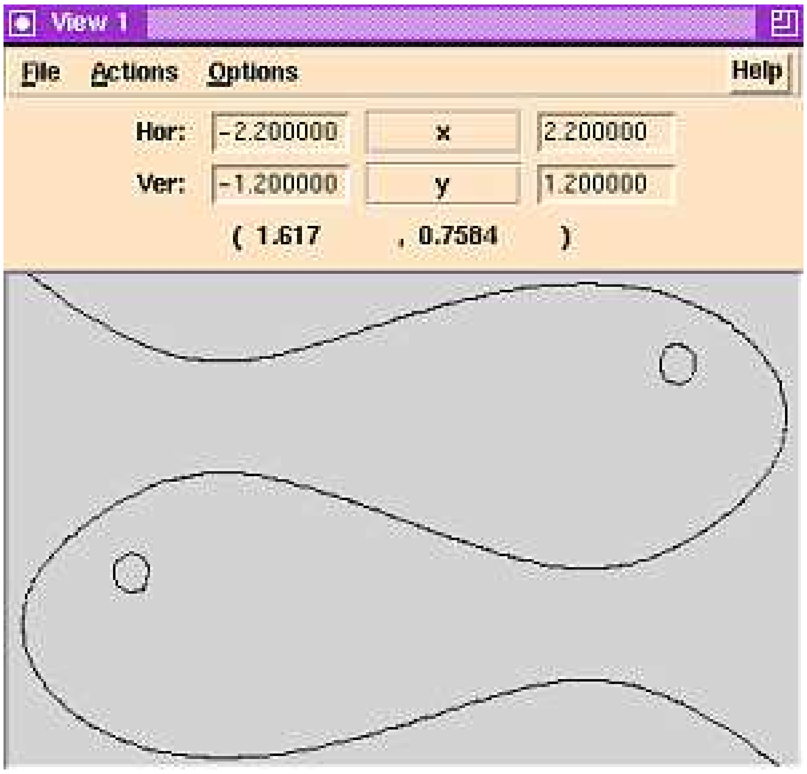
These options are primarily self-contained scripts or short modules that interact with the rest of Pisces to compute special features of implicitly-defined object.

- Animate: Compute level sets for a one-parameter family of functions as a single parameter is linearly varied.
- Parametric Animate: Compute level sets for a family of functions with two parameters. The user may select an arbitrary path through parameter space.

Model

This menu contains a list of all of the models which are currently compiled into Pisces. A **model** is Pisces' name for the current function whose level set we want to determine.

4.2 View Window



The Pisces View Window.

The View Window displays a two-dimensional projection of data produced by Pisces. The data is projected orthogonally onto the axes determined by the current value of the `Hor` and `Ver` menus.

Only data whose projection lies within the current **viewport** is displayed. The viewport is the square *[hmin, hmax] x [vmin, vmax]* where *hmin, hmax* are the values of the text entry fields adjacent to the labels `Hor` and `Ver`.

Users may have an arbitrary number of view windows open at one time. If the cursor is in a view window, then the current coordinates of the cursor is tracked by Pisces and is displayed on that view window.

There are several options from a view window:

File Menu

Print whatever is currently on the view window, or dismiss (close) the window. We remark that the "Print" option under this menu creates a postscript version of the current contents of the view window without any frills. For configurable output (with the option to indicate axes labels, titles, and the current parameters of the current model), use the option `Output->Postscript File` available from the main panel.

Action Menu

Most of the interaction with Pisces occurs through this menu:

- **Zoom In**: The user must use the right mouse button to drag out a "rubber-band box" in the view window. If the user then selects `Actions->Zoom In` then the current viewport becomes region enclosed by the rubber-band box.
- **Zoom Out**: As above, the user may drag out a "rubber-band box" in the view window, and then select `Actions->Zoom Out` in order to shrink the current viewport into the region enclosed by the rubber-band box.
- **Viewport->BBox**: Upon selection of this action, Pisces will update the current bounding box to reflect the bounds of the current viewport.
- **BBox->Viewport**: Upon selection of this action, Pisces will update the current viewport to reflect the current bounding box.
- **Erase This Window:** Clear the contents of the view window. This option does *not* actually delete any data, so by reselecting `Hor` and `Ver` axes, the current data will be redisplayed.

Options Menu

Set display options such as the width of lines in the view window.

Help Panel

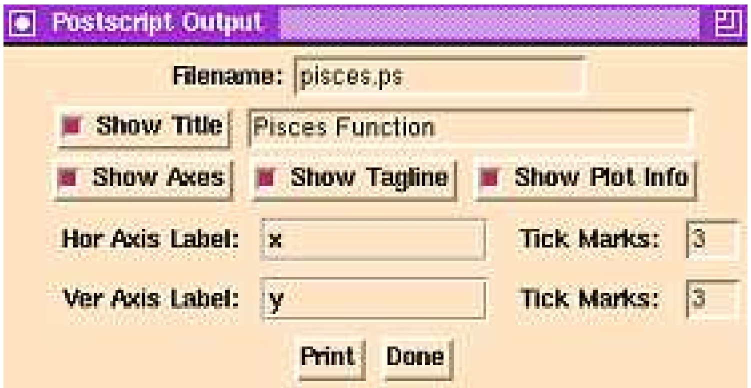
Not Yet Implemented. This panel gives on-line help about the view window.

4.3 Geomview

When a user selects `Output->Geomview`, Pisces will attempt to launch a copy of Geomview, a 3D viewing program written at the Geometry Center. Because Geomview is not available on on architectures, this option is not always available.

If Geomview is successfully launched, then Pisces will transmit graphical representations of level sets to Geomview. If the domain of the current model is not three-dimensional, then Pisces will either project the level set onto three dimensions, or else augment the domain by range variables or parameters in order to create a three dimensional data set. The user may control which three coordinates are sent to Geomview by using the Geomview Settings Panel which may be accessed from the main panel.

4.4 Postscript Printing



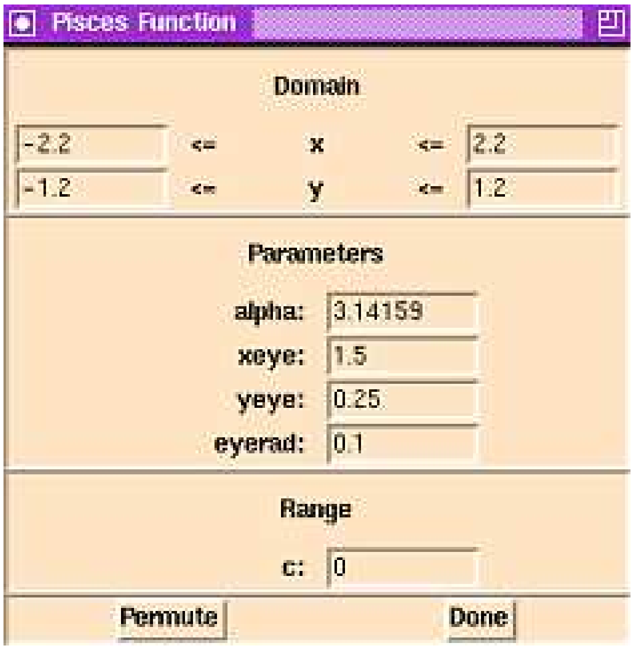
The Pisces Postscript Panel.

If a computed level set is a curve, then Pisces can create a postscript file containing the projection of that curve onto any two coordinates. The region printed will be the projection of the current bounding box onto the chosen coordinate axes.

The following options appear on the postscript panel:

- **Filename**: The name of the postscript file that Pisces will write to. Currently, Pisces will overwrite this file, even if it is not empty.
- **Show Title**: If checked, the string following the checkbox will appear at the top of the postscript image as a title.
- **Show Axes**: If checked, the label and bounds of the horizontal and vertical coordinates will appear in the postscript image.
- **Show Tagline**: If checked, information on the Pisces Project will be appended to the lower right-hand corner of the postscript image.
- **Show Plot Info**: If checked, the top of the postscript image will contain information about the current model, including parameter values.
- **Hor Axis Label**: Determines the ordinate upon which the level curve will be projected. The text field following the **Tick Marks** label determines how many hashmarks to print along the horizontal coordinate.
- **Ver Axis Label**: Same as above, but determines the abscissa upon which the level curve will be projected.

4.5 Model Panel



The Pisces Model Panel.

A "model" is any of the functions for which Pisces will attempt to compute a level set. The model panel allows the user to controls each model's parameters, domain, and range.

The top of the model panel allows the user to determine the **bounding box**. The bounding box is a rectangular subset of the domain in which Pisces will attempt to compute the level set of the current model. Any portion of the level set which is outside of the bounding box will not be computed.

If the current model has parameters, then the value of these parameters may be set by modifying the text field in the middle region of the model panel.

The bottom region of the model panel includes a list of the names of the output variables. By changing the text fields in this regions, the user can compute level sets as the level is varied. For example, you may be interested in the level set f=c as c for different values of c.

The Pisces Permutation Panel.

The "Permute" button will bring up the permutation panel. This panel allow users to exchange the role of domain variables and parameters. By choosing a variable to be in the domain, you are saying that you want Pisces to allow this function to vary while it computes the level set. Domain variables are sometimes called "active variables" whereas parameters are sometimes called "inactive variables."

Important: after making a change to the permutation panel, you **must** press the "Apply" button on the permutation panel, or your change will not be implemented! In order to ensure that you either "apply" your change or cancel it, the permutation panel grabs the screen's "focus" and will not let you proceed in Pisces until you have applied or canceled your change.

Pisces comes with a set of pre-installed models. Documentation on the definitions of pre-installed models is available in another section of this documentation.

4.6 The Output Panel

The Pisces Output Panel.

The output panel allows the user to control aspects of the way that Pisces sends its output data to graphics devices.

New geometry

> If this field is set to "replaces last," then every time an algorithm is used to compute a level set, the old data is deleted before the new data is sent to the graphics device. If this field is set to "adds to last," then old data is not deleted.

4.7 The Jacobian Panel

The Pisces Jacobian Panel.

The Jacobian panel allows the user to set parameters used by Pisces for taking numerical derivatives and for finding roots.

The top of the Jacobian panel contains fields that determine how Pisces computes finite-difference derivatives.

The remainder of the panel determines stopping criteria for Newton's methods of finding roots.

epsi_func

If the norm of the model evaluated at a point x is less than the value of this field, then x is determined to be a zero of the model.

epsi_vars

During Newton's method, if the size of the Newton step distance is less than the value of this field, then we stop Newton's method because we are either not converging to a root or are converging very slowly.

newt_step

The value of this field determines the number of Newton steps we are allowed to take before deciding that an initial guess will never converge to a root.

Important: after making a change to the Jacobian panel, you **must** press the "Update" button, or your change will not be implemented!

4.8 The Derived Model Panel

The Pisces Derived Model Panel.

Perhaps one of the most powerful features of Pisces is its ability to create new models from pre-existing models. This process of "deriving" a new model is carried out via the derived model panel. We call the process of converting from one model to another model a **derivation**.

To aid in the explanation, we will refer to the **coded model**. The coded model is the model *as it is originally defined*. This determines the dimensions of the "coded domain," and the "coded range."

Let F denote the current model. The domain of the model is determined by the current state of the model panel and may be changed using the permutation panel.

The currently-implemented derived models are:

None

Find level sets of the current model. The range of the current model is the same as the coded range.

Fixed Points Map

Find level sets of the model $f(x) = F(x)\text{-}x$. In order for this derivation to make sense, the dimension of the coded domain of F must equal the dimension of the coded range of F. Naturally, in order to compute a level set of f in Pisces, the user must inflate the domain by at least one variable using the permutation panel.

Saddle Node Map

Find level sets of the system *f1(x) = F(x)-x*, *f2(x) = det(DF(x)-I)* where I is the identity matrix. In order for this derivation to make sense, the dimension of the coded domain of F must equal the dimension of the coded range of F. In order to compute a level set of f in Pisces, the user must inflate the domain by at least two variables using the permutation panel.

Fixed Points ODE

Find level sets of the model *f(x) = F(x)*. (If we think of F as being a vector field, then we are finding equilibria.) In order for this derivation to make sense, the dimension of the coded domain of F must equal the dimension of the coded range of F. Naturally, in order to compute a level set of f in Pisces, the user must inflate the domain by at least one variable using the permutation panel.

Saddle Node ODE

Find level sets of the system *f1(x) = F(x)*, *f2(x) = det(DF(x))*. In order for this derivation to make sense, the dimension of the coded domain of F must equal the dimension of the coded range of F. In order to compute a level set of f in Pisces, the user must inflate the domain by at least two variables using the permutation panel.

Planar_Singularity

This derivation only makes sense if F is a scalar-valued function of two variables. Then the derivation is *f1(x)=F(x)*, *f2(x)=grad(F)*. The solutions to this system are singular points on the level sets of F. In order to compute a level set of f in Pisces, the user must inflate the domain by at least two variables using the permutation panel.

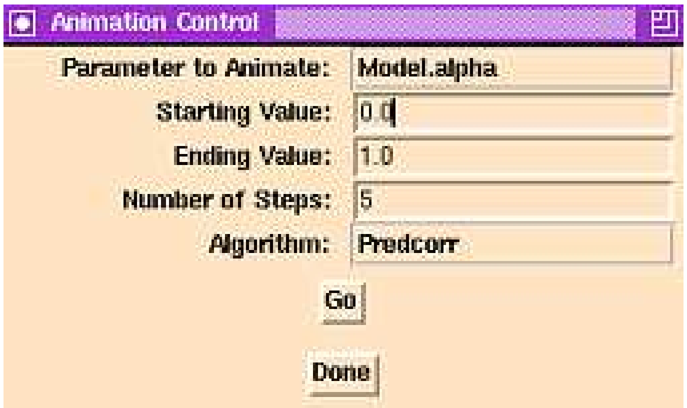
4.9 The Geomview Settings Panel

The Pisces Geomview Settings Panel.

The Geomview Settings Panel controls the variables that Pisces sends to Geomview. This panel can only be opened if Geomview is installed on your computer network and if Pisces knows its location.

The panel determines the variable and the order of data sent to Geomview. For example, *(x,y,z)* data may be sent as *(x,y,z)*, *(x,z,y)*, *(z,x,y)*, etc. Anytime a change is made to the panel, the **Apply** button must be pressed before Pisces will resend the current data to Geomview.

4.10 The Animation Panel



The Pisces Animation Panel.

The Animation panel allows users with interactive output devices to see a sequence of level sets in a one-parameter family of models.

4.10.1 How it works

The animation is created by the following algorithm:

- The step size is computed by taking the difference between **Ending Value** and **Starting Value** and dividing that difference by the **Number of Steps**.
- The value of the **Parameter to Animate** is saved.
- The value of the **Parameter to Animate** is set to the **Starting Value**.
- The **Algorithm** is called to compute the level set.
- The **Parameter to Animate** is incremented by step size.
- If the value of **Parameter to Animate** is less then or equal to the **Ending Value** then go to the previous step.
- The value of the **Parameter to Animate** is restored.

4.10.2 Controlling the Animation Panel from Pisces

The Animation panel has the following fields:

Parameter to Animate

From the menu of the current model parameters, the selected parameter is the one which will be animated.

Starting Value

The value that the selected parameter takes for the first frame of the animation.

Ending Value

The value the selected parameter takes for the last frame of the animation.

Number of Steps

The number of frames of animation that will be produced. This must be a positive integer.

Algorithm

This menu selection determines method of computing the level set. The parameters for each algorithm may be set using the control panel specific to each algorithm.

To see the animation press the **Go** button. At any time after that during the animation you may stop it by pressing the **Interrupt** button which replaced the **Go** button for the duration of the animation.

Known Bugs

The menu's in the Animation Control panel do not change when the model is changed. The result is that the panel must be closed and reopened before the correct list of parameters is available. In addition, the currently selected parameter must be reselected as it is not reset when the panel is reopened.

In addition there is not check to make sure that the algorithm will work with the given model. This flaw is not specific to the Animation panel but does affect it's operation.

Bug Reports

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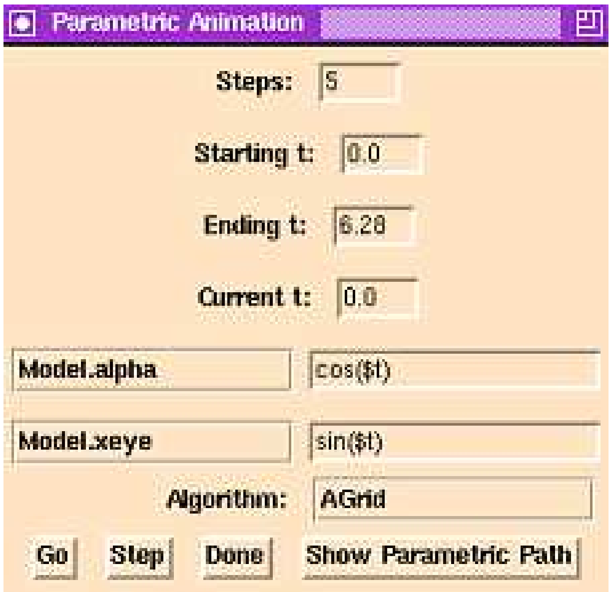
Implemented By

Mark Phillips. Popup menus added by John Golden and Erik Streed.

4.11 The Parametric Animation Panel



The Pisces Parametric Animation Panel.

The parametric animation panel can animate a two-parameter family of model along a one-parameter path in parameter space. In other words, if a model depends on the parameters *(a,b)*, then the parametric animation panel allows the user to animate level sets of the model along any path *(a(t), b(t))*.

4.11.1 How it works

The animation is created by the following algorithm:

- The step size is computed by taking the difference between **Ending t** and **Starting t** and dividing the difference by the **Steps**.
- The current values values of the parameters to animate are saved. We will denote these parameters as *(a,b)*.

- The value of **Current t** is set to the value of **Starting t**. This value and the Tcl expressions next to the parameters to animate are used to determine the point *(a(t0), b(t0))* which will be used as the parameter values for the initial level set.
- The **Algorithm** is called to compute the level set.
- The value of **Current t** is incremented by step size.
- If the value of **Current t** is less then or equal to the **Ending t** then go to the previous step.
- The value of the animation parameters are restored.

4.11.2 Controlling the Algorithm from Pisces

The parametric animation panel has the following fields:

Steps

The number of frames of animation that will be produced. This must be a positive integer.

Starting t

The value that the independent variable takes for the first frame of the animation.

Ending t

The value the independent variable takes for the last frame of the animation.

Current t

The current value of the independent variable.

Variable/Expression

The menus and Tcl expression in these fields determine the parameters to animate and determine the parametric paths that the parameters will follow. The main point to remember about Tcl expressions is that you must place a $ (dollar sign) in front of the name of the variable (which is always t).

Algorithm

This menu selection determines method of computing the level set. The parameters for each algorithm may be set using the control panel specific to each algorithm.

To see the animation press the **Go** button. To step through the animation one frame at a time, you may press the **Step** button.

The animation path you have specified may be viewed by pressing the **Show Parametric Path** button.

Known Bugs

Same as for the animate panel. Also, the name of the independent variable *must* be *t*.

Bug Reports

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Implemented By

John Golden and Erik Streed.