Appendix A

Colors and linestyles.

XPPAUT uses the numbers from 0-10 to describe colors of plots. These are translated into linestyles for black-and-white postscript files. Here are the color numbers and their approximate names. Figure A shows the corresponding linestyles for black-and-white postscript.

Color 0: Black on a white screen and white on a black screen.

Color 1: Red.

Color 2: Red-orange.

Color 3: Orange.

Color 4: Yellow-orange.

Color 5: Yellow.

Color 6: Yellow-green.

Color 7: Green.

Color 8: Blue-green.

Color 9: Blue.

Color 10: Purple.

Keep these in mind for hardcopy. For example to change the linetype of the null-clines change the color that they are plotted in the program using the options shown in Appendix B and then when hardcopy is made, the linetype will be as shown in the figure. Negative linetypes in *XPPAUT* do not join the points together and instead draw either single points (`LT=0`) or circles or varying diameter, `LT=-1,-2` `,...`
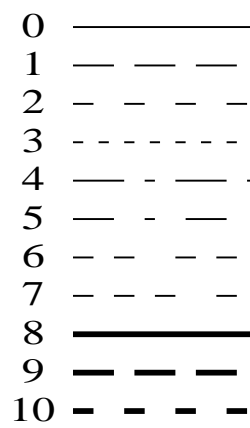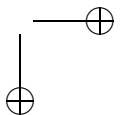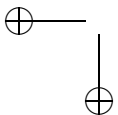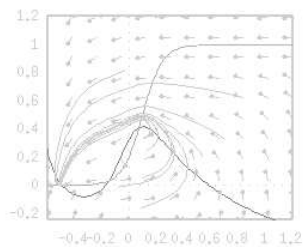
255
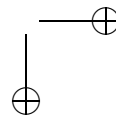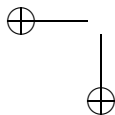
Figure A.1. *Available postscript linestyles.*

Appendix B

The options

XPPAUT enables the user to incorporate a large number of options within an ODE file. These have the form:

```
@ opt1=value,opt2=value2,...
```

where `opt1` is the name of an option and `value` is the assigned value. Almost every option can also be set within *XPPAUT* from the menus. Similarly, most items that you want to set in *XPPAUT* can be set in the ODE file.

The following options *can only be set outside the program.* They are:

- MAXSTOR=`integer` sets the total number of time steps that will be kept in memory. The default is 5000. If you want to perform very long integrations change this to some large number.

- BACK= {`Black,White`} sets the background to black or white.

- SMALL=`fontname` where `fontname` is some font available to your X-server. This sets the "small" font which is used in the Data Browser and in some other windows.

- BIG=`fontname` sets the font for all the menus and popups.

- SMC={0,...,10} sets the stable manifold color

- UMC={0,...,10} sets the unstable manifold color

- XNC={0,...,10} sets the X-nullcline color

- YNC={0,...,10} sets the Y-nullcline color

- OUTPUT=filename sets the filename to which you want to write for "silent" integration. The default is "output.dat".

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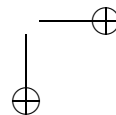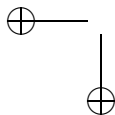
- BUT=label:sequence. This option can be used repeatedly in the same file and allows you to define a clickable button on the top menu bar of the main window. The `label` defines the label that will appear on the button and the `sequence` is a sequence of keys used for the command. These are the keys you would press to get an item from the main menu (see Appendix E.) For example, if you want to have a one click command for computing the Liapunov exponent, the sequence is `uhl` since you would press nUmerics stocHastic Liapunov . Thus, the option is `BUT=liap:uhl`. A quit button would be `BUT=quit:fq` corresponding to File . Quit .

The remaining options can be set from within the program. They are

Plotting options.

- LT=`int` sets the linetype. It should be less than 2 and greater than -6.
- XP=name sets the name of the variable to plot on the x-axis. The default is `T`, the time-variable.
- YP=name sets the name of the variable on the y-axis.
- ZP=name sets the name of the variable on the z-axis (if the plot is 3D.)
- NPLOT=`int` tells XPP how many plots will be in the opening screen.
- XP2=name,YP2=name,ZP2=name tells XPP the variables on the axes of the second curve; XP8 etc are for the 8th plot. Up to 8 total plots can be specified on opening. They will be given different colors.
- AXES={`2,3`} determine whether a 2D or 3D plot will be displayed.
- PHI=value,THETA=value set the angles for the three-dimensional plots.
- XLO=value,YLO=value,XHI=value,YHI=value set the limits for two-dimensional plots (defaults are 0,-2,20,2 respectively.) Note that for three-dimensional plots, the plot is scaled to a cube with vertices that are ±1 and this cube is rotated and projected onto the plane so setting these to ±2 works well for 3D plots.
- XMAX=value, XMIN=value, YMAX=value, YMIN=value, ZMAX=value, ZMIN=value set the scaling for three-d plots.

Numerical options

- SEED=`int` sets the random number generator seed.
- TOTAL=value sets the total amount of time to integrate the equations (default is 20).
- DT=value sets the time step for the integrator (default is 0.05).
- NJMP=`integer` or NOUT=`integer` tells *XPPAUT* how frequently to output the solution to the ODE. The default is 1, which means at each integration step. This is also used to specify a the period for maps in the continuation package AUTO.
- T0=value sets the starting time (default is 0).
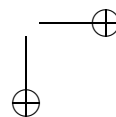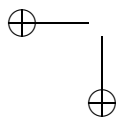
- TRANS=value tells XPP to integrate until `T=TRANS` and then start plotting solutions (default is 0.)
- NMESH=`integer` sets the mesh size for computing nullclines (default is 40).
- {BANDUP=int, BANDLO=int} sets the upper and lower limits for banded systems which use the banded version of the CVODE integrator.
- METH={ `discrete,euler,modeuler,rungekutta,adams,gear,volterra,` `backeul, qualrk,stiff,cvode,5dp,83dp,2rb,ymp`} sets the integration method (see below; default is Runge-Kutta.) The latter four are the Dormand-Prince integrators and a Rosenbrock (2,3) integrator and a symplectic integrator.
- DTMIN=value sets the minimum allowable timestep for the Gear integrator.
- DTMAX=value sets the maximum allowable timestep for the Gear integrator
- VMAXPTS=value sets the number of points maintained in for the Volterra integral solver. The default is 4000.
- { JAC_EPS=value, NEWT_TOL=value, NEWT_ITER=value} set parameters for the root finders.
- ATOLER=value sets the absolute tolerance for several of the integrators.
- TOLER=value sets the error tolerance for the Gear, adaptive RK, and stiff integrators. It is the relative tolerance for CVODE and the Dormand-Prince integrators.
- BOUND=value sets the maximum bound any plotted variable can reach in magnitude. If any plottable quantity exceeds this, the integrator will halt with a warning. The program will not stop however (default is 100.)
- DELAY=value sets the maximum delay allowed in the integration (default is 0.)
- AUTOEVAL={`0,1`} tells XPP whether or not to automatically re-evaluate tables every time a parameter is changed. The default is to do this. However for random tables, you may want this off. Each table can be flagged individually within XPP.

Poincare map

- POIMAP={ `section,maxmin,period`} sets up a Poincare map for either sections of a variable, the extrema, or period between events.
- POIVAR=name sets the variable name whose section you are interested in finding.
- POIPLN=value is the value of the section; it is a floating point.
- POISGN={ `1, -1, 0` } determines the direction of the section.
- POISTOP=1 means to stop the integration when the section is reached.
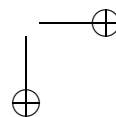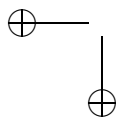
Range integration

- RANGE=1 means that you want to run a range integration (in batch mode).
- RANGEOVER=name, RANGESTEP, RANGELOW, RANGEHIGH, RANGERESET=Yes,No, RANGEOLDIC=Yes,No all correspond to the entries in the range integration option.

Phasespace

- TOR_PER=value, defined the period for a toroidal phasespace and tells XPP that there will be some variables on the circle.
- FOLD=name, tells XPP that the variable ¡name¿ is to be considered modulo the period. You can repeat this for many variables.

AUTO options. The following AUTO-specific variables can also be set: `NTST, NMAX, NPR, DSMIN, DSMAX, DS, EPSS,EPSL,EPSU, PARMIN,PARMAX, NORMMIN, NORMMAX, AUTOXMIN, AUTOXMAX, AUTOYMIN, AUTOYMAX, AUTOVAR`. The last is the variable to plot on the y-axis. The x-axis variable is always the first parameter in the ODE file unless you change it within AUTO.

Miscellaneous

- AUTOEVAL={1,0} tells *XPPAUT* whether or not to recompute tables whenever parameters are changed. If you have a table of random connectivity, you want this turned off (0).
- BELL=0 turns of the bell for *XPPAUT* .
- COLORMAP={0,1,2,3,4,5} switches the color map:
    - 0: standard
    - 1: periodic
    - 2: "hot"
    - 3: "cool"
    - 4: red-blue
    - 5: grey