1 Introduction

This is the latest version of XPPAUT. I will be working on a revised version of the book, so this document will be brief but should fill you in on most of the differences. The biggest difference is that I have upgraded the version of AUTO. As a side benefit, I have also gotten XPP to compile and run as a 64 bit program. This aspect is invisible to the user; the main reasons I did it are (1) the 32 bit libraries are being phased out in many platforms and (2) I have discovered GPU computing and the newest version can be linked to CUDA-enabled libraries. I have also added a bunch of new features and ways to interact with ODEs so that is is somewhat similar to the iOS versions. For example, there is a slider on the animation window and you can move up and down in the array plot. There is also the ability to scroll around in the AUTO and XPP windows. So zoom in and then scroll around. Finally, there are a bunch of really useful command-line options that will let you run XPP in background and use the output to pipe into your own program.

There are lots of new menu items. You should look at the document, tree.pdf which has all the menu items and their descriptions. There are also some new features within the code. xpp_sum.pdf has all this information. Regrettably, it has been hard to keep up with the documentation, so these summary documentations are all I have for now.

2 AUTO

XPPAUT7.0 and before used AUTO-86 which was in Fortran and which I translated to C using f2c. The new version of XPPAUT uses Auto 2000 which was very nicely translated to C. This allows for more options and I think is far less likely to crash.

Here is what you get:

1. Seems to be no limit as to the size of the problem. Due to some interactions with XPP, the limit is set to 400 ODEs. This can be changed with recompilation

2. Two parameter continuations of special points of periodic orbits is now possible. This means branch points, folds, torus, fixed period, and period-doubling bifurcations can be followed in 2 parameters. Furthermore, they are color-coded so that you can see two-parameter diagrams in different colors. (The colors are hard coded; you will have to recompile to get different ones)

3. The interface to homcont is completely different and much more natural. In the old version, you had to write a complex set of BVPs that interfaced with the homcont package. Now, it is just an option in the menu that you do not have to set up specially. You need only get an approximation. However, to refine it; at present you need to add an extra parameter to

the ODE file that multiplies all the right-hand sides. Then by increasing this, you can refine the connecting orbit. You can use direct shooting to get an approximation or you and get an approximation through a large period orbit. XPP will automatically translate the orbit so that it ends near the fixed point. I will give an example below.

4. There seems to be a bug in this new version of AUTO when following phase equations for periodics. To follow a phase-equation, you need at least one variable that has a periodic solution but does not jump by 2π. So, if $x_1, \ldots, x_N$ are your phase variables defined on $[0, 2\pi)$, then add one more ODE:
$$y' = -y + sin(x_1)$$
which will have no effect on the bifurcations but introduces y which will be periodic. I find that this works.

5. New AUTO menu items. See tree.pdf

2.1 HOMCONT example

I will solve the following problem using shooting first and then refining with AUTO and finally tracking two parameters. The equations come from a bistable neural network and are found in the file bnn.ode. There is a heteroclinic connection representing a traveling front, so the idea is to find the velocity, c as a function of a parameter, th. I used shooting to get a good approximation of the velocity parameter c. There is a parameter k that multiplies the right-hand side so that you can get a better approximation of an infinite interval. Run XPPAUT on the file. Then click on Sing.Pts Go and say yes to draw the invariant sets. Next click Initialconds s(H)oot and choose 1. You now have a decent approximation of the heteroclinic. (I chose an time interval of 12 as a reasonable length, based on looking at the solution.) Fire up AUTO (File Auto) and set up the axes as Two Par. Choose k as the main parameter and c as the second parameter. Set xmin=0,xmax=100,ymin=0.ymax=10. Then open the Numerics and change Par Max to 100. Click on Run an choose Heteroclinic. The unstable dimension is 1 and the stable is 2, so those will be OK. The left equilibria are fine at 0. Change the right to U_R=1, w_R=1. This should give you a nearly horizontal line as the solution is refined to k around 100. Click on Grab and Tab to the endpoint k=100 (it will be a bit bigger). Now we have a good approximation. Now go back to Axes and choose th as the second parameter and xmax=1. Click on Run and a black curve will appear and reach a tangency at th=0.5 and c=0. Click on Grab again and Tab to k=100 again. Open Numerics and change DS=-0.02. Then Run again to get the rest of the curve. Pretty cool!

3 Command-line arguments

You can now change parameters, settings, etc from the command line and run in silent mode to get the data for any given run without altering the XPP file. You can also get nullclines and direction fields. See `xpp_sum.pdf` for details.