



FIGURE 1.  $X^TAX = 1$  and E-vectors/L-values of Hyperbolic Example

## 1. ASSIGNMENT

This lab continues to explore the connections between graphs of equations of the form

$$ax^2 + 2bxy + cy^2 = 1$$

and properties of the matrix

$$A = \begin{bmatrix} a & b \\ b & c \end{bmatrix}$$

discovered by iteration. You will be given a symmetric matrix  $H$  and for your  $2 \times 2$  matrix (like  $A$  above) you will have to use Scilab to plot (on the same plot) both the conic section (this is described in qform.pdf) and the arrows like in lambda.pdf. Explicitly your code should find the L-values and E-vectors by iterations, and compute the angle between each E-vectors and the  $x$ -axis and put the answers in table like Figure 2. Note that the entries in the table are not rounded off, they have as many digits as scilab gives by default.

## 2. HYPERBOLIC EXAMPLE

If  $A = \begin{bmatrix} -0.9056877 & -1.7043897 \\ -1.7043897 & 1.4925656 \end{bmatrix}$  then Figure 1 shows the sample plot. Important features of this plot include: 1. the scale in the  $x$  and  $y$  are the same, (an easy check: the red and green arrows are perpendicular, do they look perpendicular?); 2. The conic section is ellipse not a circle. 3. Each arrowhead just touches the curve. 4. The points of contact are extrema, points locally the nearest from the origin. 5. The region of interest is the main part of the graph (New for hyperbola). [Later labs will have other conic sections]

Hyperbola	L-value	E-vector	$\theta$ (radians)	$\theta$ (degrees)
Max	2.3773893	(0.4607547, -0.8875275)	-1.091951	-62.564184
Min	-1.7905114	(0.887528, 0.460755)	0.4788452	27.435811

FIGURE 2. Table of answers for the hyperbola  $A$

### 3. HOW THE HYPERBOLA PROBLEM IS DIFFERENT FROM THE OLD ELLIPSE PROBLEM

- (1) The Ellipse had two positive L-values, the hyperbola will have one positive and one negative L-value.
- (2) The `iterate2d.in` acts differently if the L-value is negative. Read the handout carefully because convergence is different.
- (3) The `plotquad.in` plot is slightly incorrect (why?) and plots the region of interest in a small part of the graph. To fix this you have to add a scilab command like `square(-2, -2, 2, 2)` to focus the plot on the region of interest. (In this case,  $-2 \leq x \leq 2$ ,  $-2 \leq y \leq 2$ .)
- (4) Figure 1 is slightly dishonest, you cannot take the square root of a negative L-value, but you can take the square root of the absolute value of a negative L-value.

### 4. DELIVERABLES

These are same as for Lab 5. It will be multiple pages which must be stapled. Paper clips and dog ears will earn a grade of zero. Your lab 6 assignment must be a hardcopy document, no electronic files will be accepted. If you need help, I will look at text or pdf files in email, but no word doc files. Each matrix needs a plot, a table, some code (error free and not filled with iterations). Note that the assignment is also due at 3pm Friday October 10 and not 5pm.