



FIGURE 1.  $2x^2 + 2xy + 0.5y^2 = 1$  and E-vectors/L-values of  $A = \begin{bmatrix} 2 & 1 \\ 1 & 0.5 \end{bmatrix}$

## 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 use  $P$ , a symmetric matrix  $2 \times 2$  matrix with a 0 eigenvalue. For this matrix  $P$  you will 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 non-zero L-values and E-vectors by iterations, and compute the angle between each E-vector 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. You can NOT use the built in scilab eigenvalue/eigenvector functions.

## 2. PARALLEL LINES EXAMPLE

If  $A = \begin{bmatrix} 2 & 1 \\ 1 & 0.5 \end{bmatrix}$  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 blue arrows are perpendicular, do they look perpendicular?); 2. The conic section is pair of parallel lines. (This is a degenerate conic section.) 3. Each arrowhead just touches the curve with the exception of the zero eigenvalue whose arrow is 1.5 times the length of the other arrow; 4. The points of contact are critical points nearest the origin. 5. While Figure 1 is missing labels on its arrows, your plot should label the arrows like you did for the hyperbola in Lab 6.

Parallel Lines	L-value	E-vector	$\theta$ (radians)	$\theta$ (degrees)
Max	2.500000	(0.894427, 0.447214)	0.4636476	26.565051
Min	0.0	(0.4472136, -0.8944272)	-1.1071487	-63.434949

FIGURE 2. Table of answers for the parallel lines  $A = [2, 1; 1, 0.5]$

### 3. DELIVERABLES

It will be multiple pages which must be stapled in one piece. Paper clips and dog ears will earn a grade of zero. Your lab write up must have no more than 4 pages. Your lab 7 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 due at 3pm Friday October 23 and not the old 5pm time.

#### 4. HOW THE PARALLEL LINES CASE DIFFERS FROM THE ELLIPTIC CASE

One of the L-values will be zero, which means the matrix will have no inverse. **(Because of round off errors, it may look like your matrix is non-singular in scilab, but you must do the lab assuming it is singular.)** And so the E-vector has to be computed another way (but make sure your E-vector has norm 1). The plotquad.in routine will require a square command like in the hyperbolic case. Also you can't divide by Lmin because it is zero. Make your arrow for the Emin exactly 1.5 times the length of the Emax arrow.