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> # Find the Linear Domain of Stability for an RK Method
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> restart;
  with(LinearAlgebra):
  A:=Matrix([[0,0],[1/3,1/3]]);
```

$$A := \begin{bmatrix} 0 & 0 \\ \frac{1}{3} & \frac{1}{3} \end{bmatrix}$$

```
> b:=Vector([1/4,3/4]);
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$$b := \begin{bmatrix} \frac{1}{4} \\ \frac{3}{4} \end{bmatrix}$$

```
> n:=Dimension(b);
  Id:=Matrix(n,n,shape=identity);
  T1:=Id-z*A;
  T2:=MatrixInverse(T1);
  onesvector:=Vector(n,1);
  T3:=Multiply(T2,onesvector);
  T4:=1+z*Multiply(Transpose(b),T3);
  r:=simplify(T4);
```

$$n := 2$$

$$Id := \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$$

$$T1 := \begin{bmatrix} 1 & 0 \\ -\frac{1}{3} z & 1 - \frac{1}{3} z \end{bmatrix}$$

$$T2 := \begin{bmatrix} 1 & 0 \\ -\frac{z}{-3+z} & -\frac{3}{-3+z} \end{bmatrix}$$

$$onesvector := \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

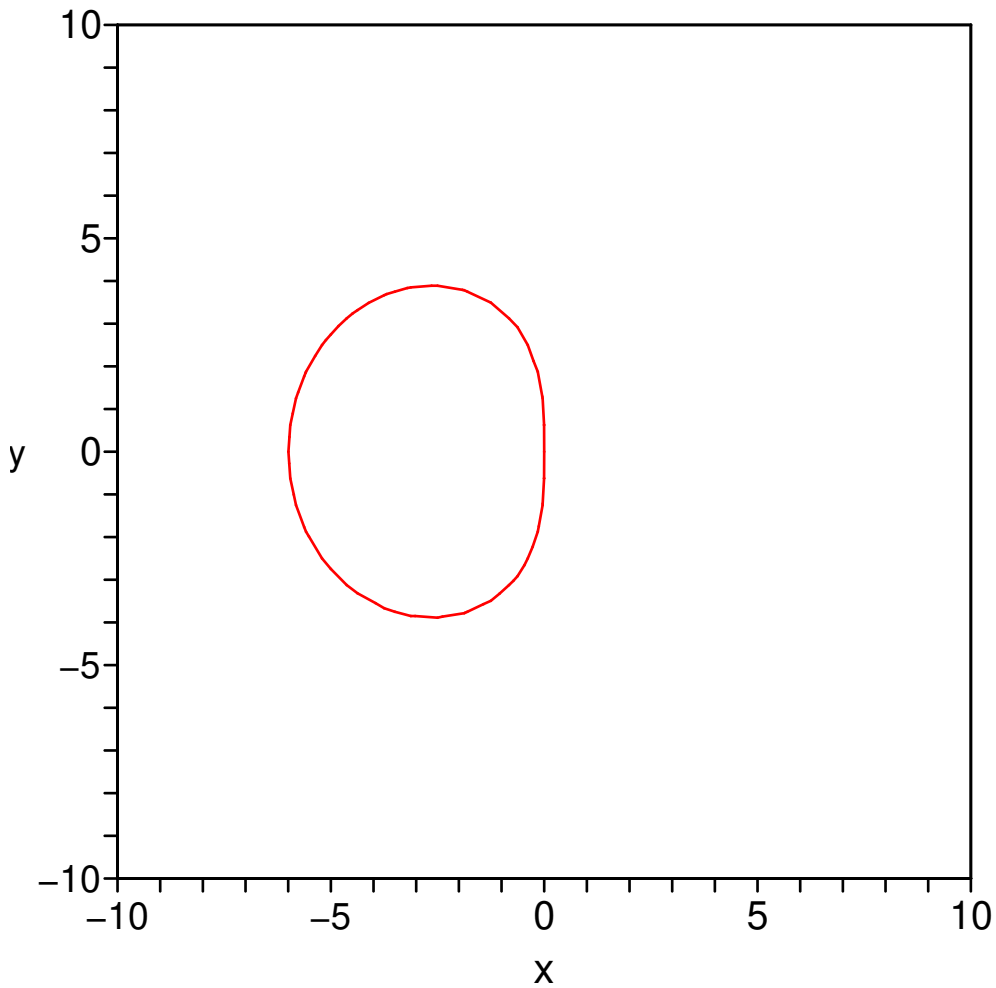
$$T3 := \begin{bmatrix} 1 \\ -\frac{z}{-3+z} - \frac{3}{-3+z} \end{bmatrix}$$

$$T4 := 1 + z\left(\frac{1}{4} - \frac{3\,z}{4\,(-3+z)} - \frac{9}{4\,(-3+z)}\right)$$

$$r := -\frac{6 + 4\,z + z^2}{2\,(-3+z)}$$

```
> with(plots):
  rxy:=subs(z=x+I*y,r);
  contourplot(abs(rxy),x=-10..10,y=-10..10,contours=[1],
     numpoints=1000,axes=boxed,view=[-10..10,-10..10]);
```

$$rxy := -\frac{6 + 4\,x + 4\,I\,y + (x + I\,y)^2}{2\,(-3 + x + I\,y)}$$

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