The algorithm"*marching squares*" for PSTricks v0.6

Manuel Luque

14 juillet 2018

1 The command \psContourPlot[options](x1,y1)(x2,y2)

If you do not know "*marching squares*", the article that Wikipedia devotes to him, very nicely illustrated, seems to me very complete :

https://en.wikipedia.org/wiki/Marching_squares

This is an adaptation of this algorithm to PSTricks, used in `\psContourPlot[options]`[1] and has the following options:

1. `[function=])` : implicit function $f(x,y)$ of the curve in algebraic or postscript mode, it should be noted that the postscript mode is the fastest;
2. `(x1,y1)(x2,y2)` : coordinates of the lower left corner and the upper right corner of the study frame, as for `\psframe(x1,y1)(x2,y2)`;
3. `[a=0.025]` : side of a (square) cell;
4. `[grid=false]` : set to `true` to draw the cell grid;
5. `[Fill=false]` : set to `true` to color the interior with the PSTricks option `[fillcolor]`;
6. `[ReverseColors=false]` : coloring inside an object is only valid for one object (a circle for instance). If there are several objects (see the 2 examples of the metaballs) it is the outside which is colored. Set to `true` this boolean to correct the problem.
7. `[ChoicePoints= liste de numéros de points]` : here we place the points where there will be an arrow on the curve, we indicate a negative value if for the positive value the arrow is not in the desired direction;
8. `[WriteData]` : boolean option allowing to save the coordinates of the points, the name of the file can be chosen with the option `[FileName=PointsCurve]`.

To solve the 2 ambiguous cases of the algorithm, I adopted the solution proposed by Xiaoqiang Zheng and Alex Pang :

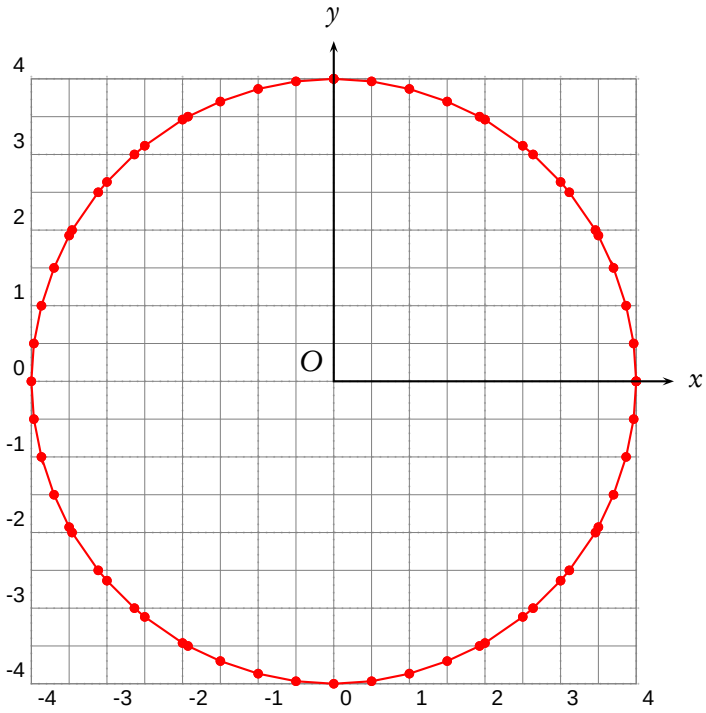
https://classes.soe.ucsc.edu/cmps161/Winter14/papers/tensor/projects/contour/paper.pdf

A second command `\psReadData[FileName=...]` allow us to draw a registered curve, the [Fill] option is not allowed.

[1] Its name comes from Mathematica:ContourPlot.

2 Examples

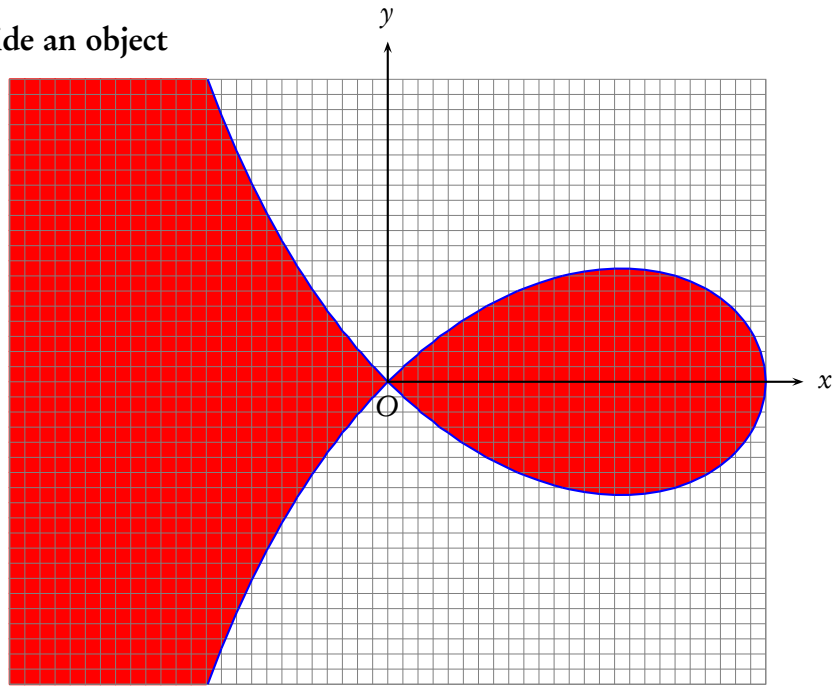
2.1 Circle




```
\psContourPlot[algebraic,a=0.5,linecolor=red,grid,function=x^2+y^2-16,showpoints,
               ChoicePoints=-4 120 -45,WriteData,FileName=circle](-4,-4)(4,4)
```

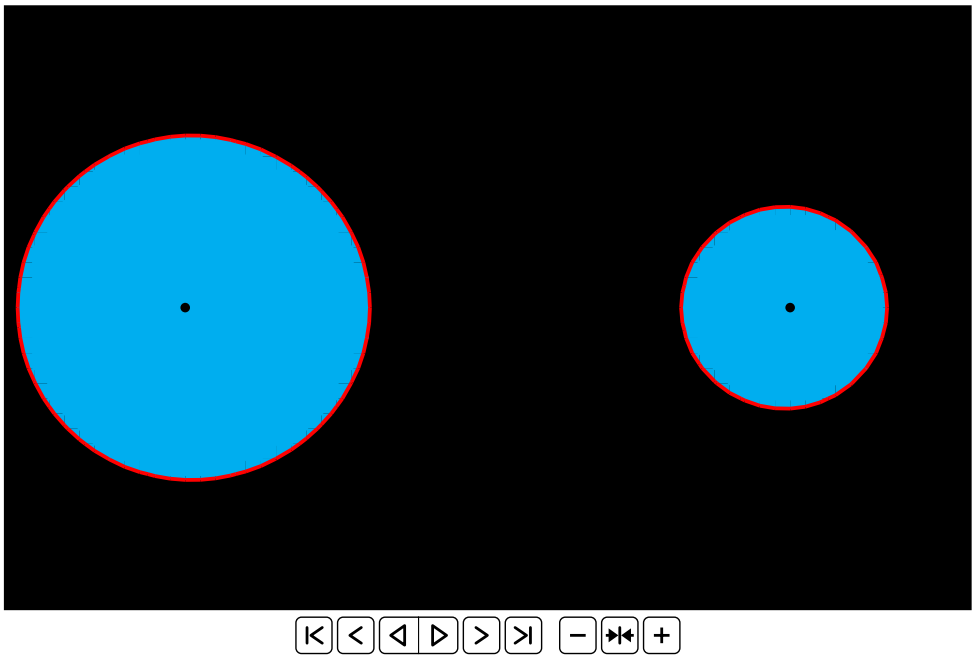
This grid contains 16 cells along the 2 axes, the side of each is 0.5 cm.

2.2 Coloring inside an object

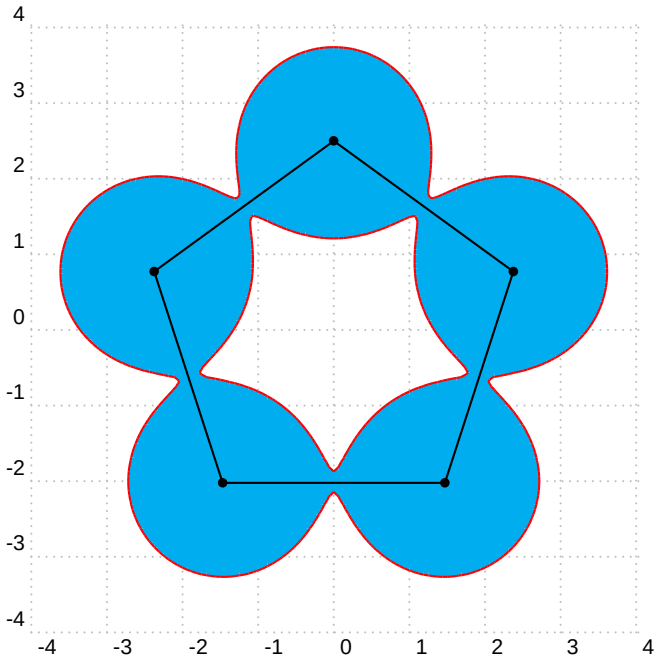



```
\psContourPlot[unit=0.5,algebraic,a=0.4,
               linecolor=blue,Fill,fillcolor=red,
               function=x*(x^2+y^2)-10*(x^2-y^2),grid](-10,-8)(10,8)
```

2.3 2D metaballs

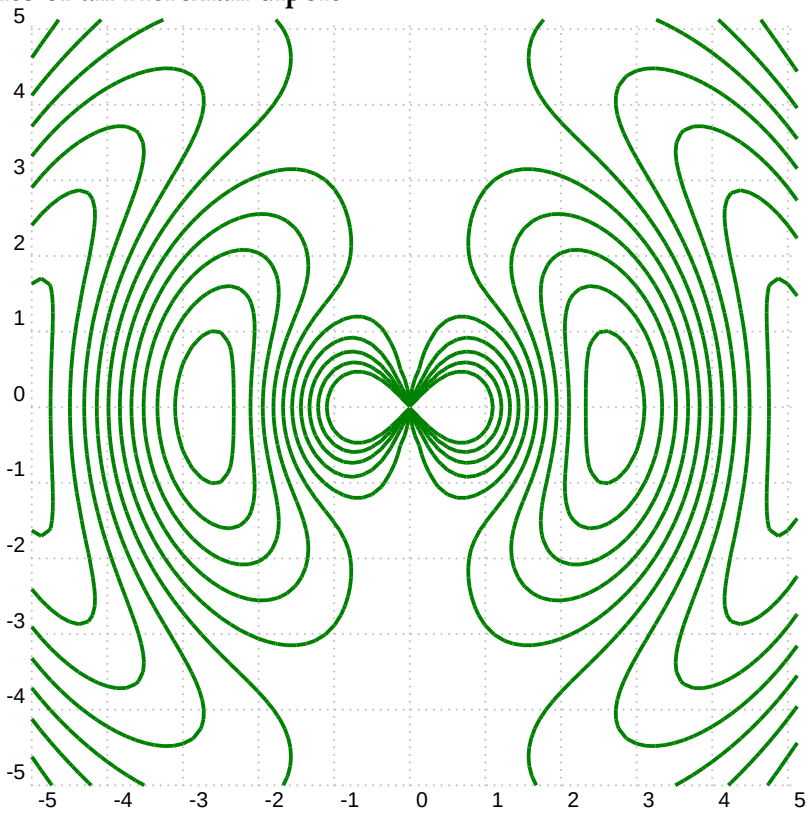



```
\begin{animateinline}[controls,palindrome,
                      begin={\begin{pspicture}(-8,-4)(8,4)},
                      end={\end{pspicture}}]{5}% 5 image/s
\multiframe{50}{r=-2+0.08}{%
\psframe*(-6.4,-4)(6.4,4)
\pstVerb{/xC \r\space def
         /FonctionMetaballs {
          1 x xC sub dup mul y dup mul add sqrt div
          0.5 x xC add dup mul y dup mul add sqrt div
          add
          1 sub
         } def}%
\psContourPlot[unit=2,a=0.1,linewidth=0.025,linecolor=red,fillcolor=cyan,Fill,ReverseColors,
               function=FonctionMetaballs](-8,-4)(8,4)
\psdots(! xC 2 mul 0)(! xC neg 2 mul 0)}
\end{animateinline}
```



```
% 5 metaballs
\begin{center}
%     1/((x-0.0001)^2+(y-1)^2)^2+
%     1/((x-0.95)^2+(y-0.309)^2)^2+
%     1/((x+0.5878)^2+(y+0.809)^2)^2+
%     1/((x-0.5878)^2+(y+0.809)^2)^2+
%     1/((x+0.95)^2+(y-0.309)^2)^2
%     -17
\begin{pspicture}[showgrid](-4,-4)(4,4)
\psset{unit=2.5}
\pstVerb{/FonctionMetaballs {
         1 x 0.0001 sub dup mul y 1     sub dup mul add dup mul div
         1 x 0.95   sub dup mul y 0.309 sub dup mul add dup mul div add
         1 x 0.5878 sub dup mul y 0.809 add dup mul add dup mul div add
         1 x 0.5878 add dup mul y 0.809 add dup mul add dup mul div add
         1 x 0.95   add dup mul y 0.309 sub dup mul add dup mul div add
         17 sub
        } def}%
\psContourPlot[a=0.05,linecolor=red,fillcolor=cyan,Fill,ReverseColors,
              function=FonctionMetaballs](-4,-4)(4,4)
\psdots(0,1)(0.95,0.309)(-0.95,0.309)(-0.5878,-0.809)(0.5878,-0.809)
\pspolygon(0,1)(-0.95,0.309)(-0.5878,-0.809)(0.5878,-0.809)(0.95,0.309)
\end{pspicture}
```

2.4 The field lines of an Hertzian dipole




```
\pstVerb{/t 0 def /k0 2 PI mul def}%
\multido{\rc=-1.1+0.2}{11}{
\psContourPlot[unit=5,a=0.025,linewidth=0.01,linecolor={[rgb]{0 0.5 0}},
   function=/r x dup mul y dup mul add sqrt k0 mul def
                   /theta x y atan def
   r t sub COS r t sub SIN r div add theta sin dup mul mul \rc\space sub](-1,-1)(1,1)}
```

3 Complements

Examples are included in the documentation, but you will find other examples on the blog :

http://pstricks.blogspot.com/

and as an application dedicated to physics, the drawing of magnetic field lines of parallel wires :

http://pstricks.blogspot.com/2018/07/champs-magnetiques-crees-par-des-fils.html