⊞— PLOT

⊟— Examples

Vector Fields Quiver Examples

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

Notation "Box":

$B = \begin{bmatrix} xmin & xmax \\ ymin & ymax \end{bmatrix}$ $N = \begin{bmatrix} nx \\ ny \end{bmatrix}$ $CM := pCmapJet(200, 0.9)$

$f(x, y) := \begin{bmatrix} \sqrt{|y|} \cdot \cos(x) \\ 2 \cdot y \cdot \sin(x) \end{bmatrix}$

$\begin{bmatrix} B := \begin{bmatrix} -5 & 5 \\ -5 & 5 \end{bmatrix} & N_{IC} := \begin{bmatrix} 6 \\ 6 \end{bmatrix} & N_Q := 4 \cdot N_{IC} \end{bmatrix}$

$G := pGrid("f", B, N_Q)$

$Q := pQuiver(G, B, N_Q)$

$cm := pClr(\overrightarrow{norme(G)}, CM)$

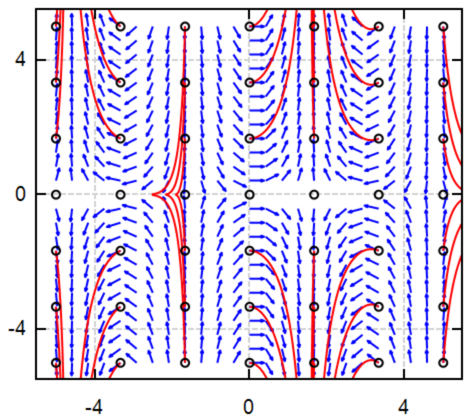
$RK(x, y) := RK("f", x, y, 4)$

$IC := pGrid("RK", B, N_{IC})$

$O := \overrightarrow{augment(row(IC, 1), "o", 4)}$

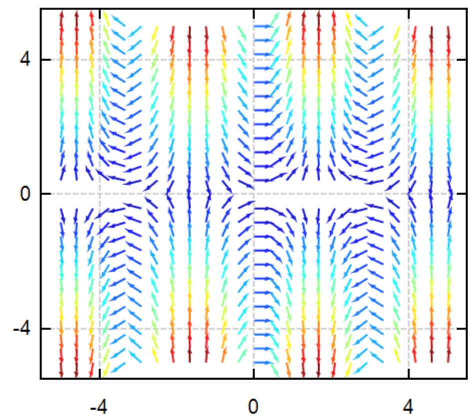
$pIC := \begin{cases} pCycleColors(Q) \\ "" \\ pCycleColors(IC) \\ pCycleColors(O) \end{cases}$

Ingegral Curves & monochrome VF



pIC

Map Colored Vector Field



$\left[\overrightarrow{pXYLine(Q, cm)}\right]$

"Range" Notation:

$X = pR(xmin, xmax, nx)$ $Y = pR(ymin, ymax, ny)$

$f(x, y) := \begin{bmatrix} y \\ x^2 - x - 2 \cdot y \end{bmatrix}$

$X := pR(-3, 3, 20)$

$Y := pR(-3, 3, 20)$

$G := pGrid("f", X, Y)$

$Q := pQuiver(G, X, Y)$

$cm := pClr(\overrightarrow{norme(G)}, CM)$

$xo := pR(-3, 3, 6)$

$yo := pR(-3, 3, 6)$

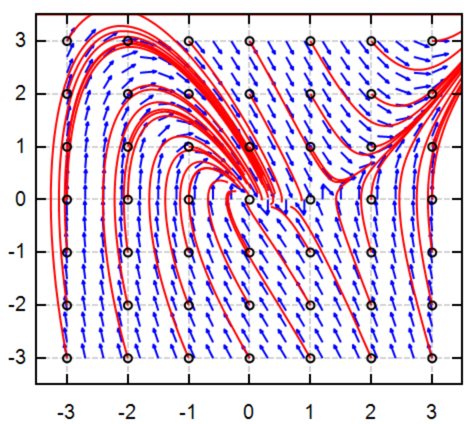
$RK(x, y) := RK("f", x, y, 2)$

$IC := pGrid("RK", xo, yo)$

$O := \overrightarrow{augment(row(IC, 1), "o", 4)}$

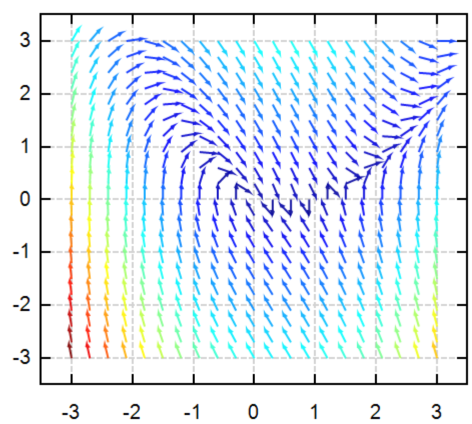
$pIC := \begin{cases} pCycleColors(Q) \\ "" \\ pCycleColors(IC) \\ pCycleColors(O) \end{cases}$

Ingegral Curves & monochrome VF



pIC

Map Colored Vector Field



$\left[\overrightarrow{pXYLine(Q, cm)}\right]$

Potential and Gradient example

$$f(x, y) := x \cdot y + x \cdot \cos(y)$$

$$g(x, y) := \left[\frac{d}{dx} f(x, y) \quad \frac{d}{dy} f(x, y) \right]^T$$

$$\left[B := \begin{bmatrix} -6 & 6 \\ -\pi & \pi \end{bmatrix} \quad N := \begin{bmatrix} 8 \\ 4 \end{bmatrix} \quad C := 0.1 \cdot [-4 .. 4] \right]$$

$$Q := pQuiver(\text{"g"}, B, 4 \cdot N)$$

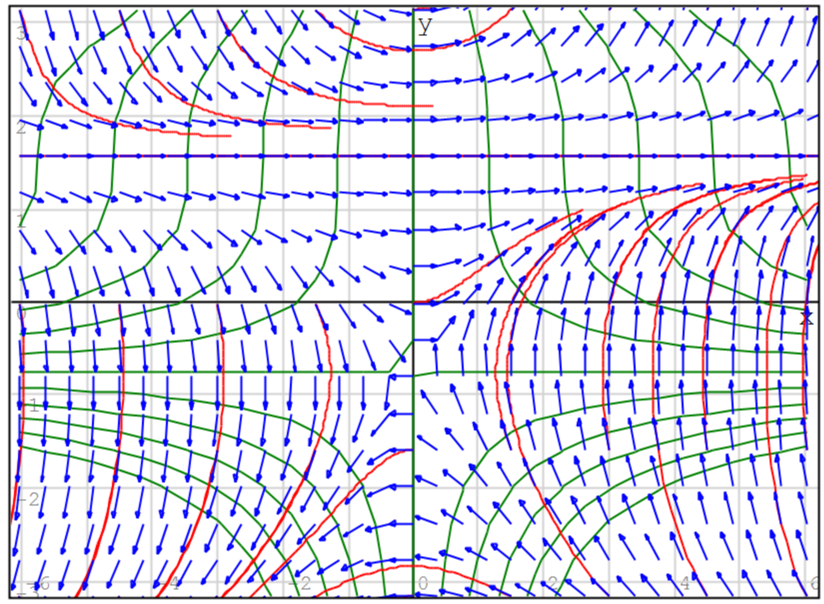
$$RK(x, y) := \left| RK(\text{"g"}, x, y, 2) \right.$$

$$IC := pGrid(\text{"RK"}, B, N)$$

$$\lambda := pR(-9, 9, 10)$$

$$L := pIPlot(\text{"f"}, B, 4 \cdot N, \lambda)$$

$$Plot := \begin{cases} pCycleColors(Q) \\ \text{""} \\ pCycleColors(IC) \\ \text{""} \\ pCycleColors(L) \end{cases}$$



Plot

Electric Field

U = *Pontetial*
E = *Field*

$$\begin{cases} k := 9 \\ Q := [1 \ 3 \ -2 \ -1] \\ P := \begin{bmatrix} 4 & -3 & 1 & -4 \\ -3 & -2 & 2 & 0 \end{bmatrix}^T \end{cases}$$

Constant Charges

Place Points

$$\begin{cases} B := \begin{bmatrix} -5 & 5 \\ -5 & 5 \end{bmatrix} \\ N := [9 \ 9] \end{cases}$$

Box Plot

Steps

$$U(x, y) := \sum_{n=1}^{4} \frac{k \cdot Q_n}{\sqrt{\left(x - P_{n\,1}\right)^2 + \left(y - P_{n\,2}\right)^2}}$$

$$h := 0.0000001$$

$$E(x, y) := \left| \begin{array}{l} U := U(x, y) \\ E := \begin{bmatrix} U(x + h, y) - U \\ U(x, y + h) - U \end{bmatrix} \\ \dfrac{-E}{\text{norme}(E)} \end{array} \right.$$

$$G := pGrid(\text{"E"}, B, 4 \cdot N)$$

$$Q := pQuiver(G, B, 4 \cdot N)$$

$$RK(x, y) := RK(\text{"E"}, x, y, 4)$$

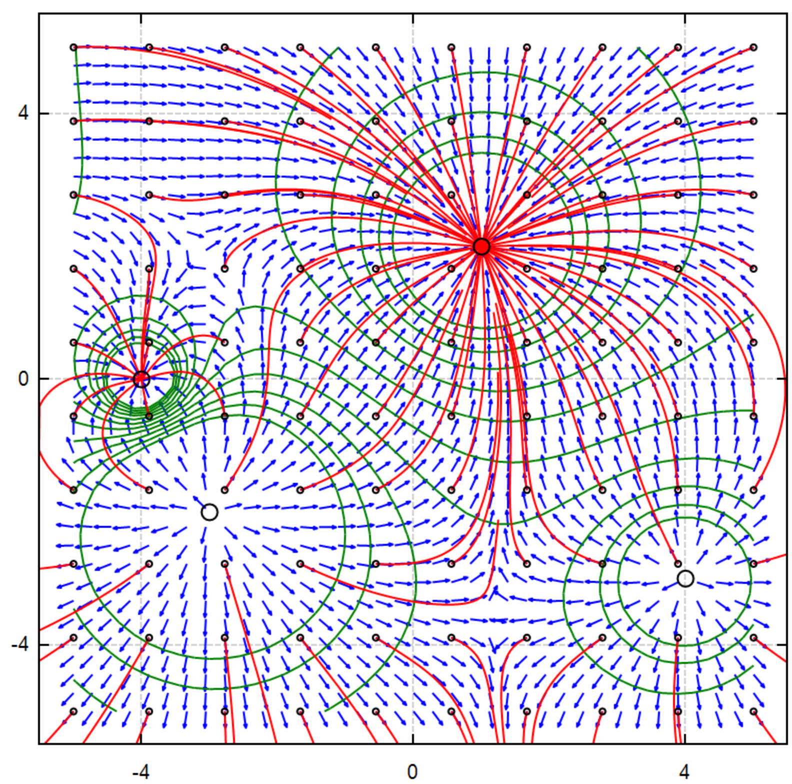
$$IC := pGrid(\text{"RK"}, B, N)$$

$$O := \text{eval}\left(\overrightarrow{\text{augment}(\text{row}(IC, 1), \text{"o"}, 3)}\right)$$

$$\lambda := pR(-k, k, 10)$$

$$L := pIPlot(\text{"U"}, B, 5 \cdot N, \lambda)$$

$$Plot := \begin{cases} pCycleColors(Q) \\ \left[\overrightarrow{pXYLine(L, \text{"green"})} \right] \\ pCycleColors(IC) \\ \text{mat2sys}_1(O) \\ \text{augment}(P, \text{"o"}) \end{cases}$$



Plot

Note: E isn't the field, it is divided by it's norme for stabilizing the RK method

The integral curves (red) are the paths that positive test charges placed in the field would take, and they are collinear with the vector field (blue) and perpendicular to the potential contour lines (green).

Alvaro