

3D- ODE examples in 3D-XplorMath*

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3D 2nd Order: $(x' = u, y' = v, z' = w)$

coupled Oscillator:

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix}'' = \begin{pmatrix} -aa^2x + dd(y - x) + ee(z - x) - gg u \\ -bb^2y + dd(x - y) + ff(z - y) - hh v \\ -cc^2z + ee(x - z) + ff(y - z) - ii w \end{pmatrix}$$

forced Oscillator:

$$\begin{pmatrix} x \\ y \\ z \end{pmatrix}'' = \begin{pmatrix} -aa^2x + bb \cos(cc \cdot t) \\ -dd^2y + ee \cos(ff \cdot t) \\ -gg^2z + hh \cos(ii \cdot t) \end{pmatrix}$$

The ODE for a **charged particle** in a magnetic field M :
 $\vec{x}' = \vec{u}$, $\vec{x}'' = \vec{u}' = \vec{u} \times M(x, u)$, charge and mass are 1.

const Magnetic Field: $M(\vec{x}) := (aa, bb, cc)^t$

Magnetic Field of straight wire:

$$\begin{aligned} \vec{wire} &:= (aa, bb, cc)^t / \sqrt{aa^2 + bb^2 + cc^2} \\ \vec{px} &:= \vec{x} - \langle \vec{x}, \vec{wire} \rangle \cdot \vec{wire}, \quad rr := |\vec{px}|^2 \\ M(\vec{x}) &:= dd/rr \cdot (\vec{wire} \times \vec{px}) \end{aligned}$$

Toroidal Magnetic Field:

$$M(\vec{x}) := (2y, -2x, 0)/(x^2 + y^2)$$

Magnetic Dipole Field:

* This file is from the 3D-XplorMath project. Please see:

<http://3D-XplorMath.org/>

$$rr := x^2 + y^2 + z^2$$
$$eDOTp := aa x + bb y + cc z$$

$$M(\vec{x}) := \left(\frac{3x}{rr - aa}, \frac{3y}{rr - bb}, \frac{3z}{rr - cc} \right) \frac{eDOTp}{rr^{3/2}}$$