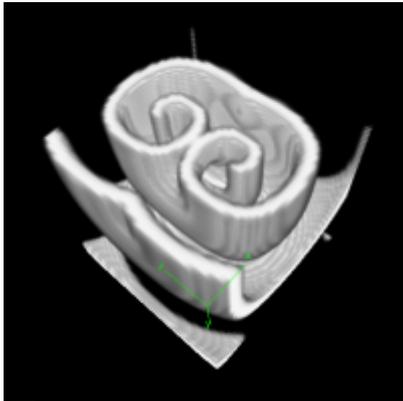# Reaction-diffusion models

3D reaction-diffusion: Excitable Media

Scroll wave appear in Barkley model of excitable media in 3D

Introduction

This example uses the Barkley model of excitable media, similar to the Fitzhugh-Nagumo model to show how to model and visualize reaction-diffusion models in 3D.

Model description

This model defines a 3D `cubic` `Lattice` with `noflux` `BoundaryConditions`. Two `Layers` are defined for the two species: 'u' is the signal, and 'v' the refractoriness. As in the examples above, the `DiffEqn` as specified in the `System` in PDE. Nothing strange here.

To visualize the resulting scrolling waves in 3D, the `TiffPlotter` is used. This `Analysis` plugin writes TIFF image stacks that cam be opened by image analysis software such as Fiji/ImageJ. To import Morpheus TIFF images into Fiji, macros scripts are available that help you to create 3D (xyz), 4D (xyzt) or even 5D (xyzct) images and movies of your simulations.

Although unable to plot 3D, the `GnuPlotter` can still be helpful to plot a 2D slice. See Analysis/Gnuplotter/PDE/slice.

Model

h ExcitableMedium_3D.xml |h

```
extern>http://imc.zih.tu-dresden.de/morpheus/examples/PDE/ExcitableMedium_3D
.xml
```

In Morpheus GUI: Examples → PDE → ExcitableMedium_3D.xml

Things to try

- Import resulting sequence of TIFF images in ImageJ or Fiji, and create 4D movie using ImageJ's 3D plugin:
  1. Open u_v.tif in ImageJ: File → Open.
  2. Create hyperstack: Image → Hyperstack → Convert to Hyperstack. Channels (c): 2, Slices (z): 50, Frames (t): 51, Display Mode: Composite.
  3. Display in 4D: Plugins → 3D Viewer. Use default parameters. Press OK.

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