

Module 4: Vascular Patterning

Author:

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Aim:

- Learn to distinguish between alternative hypothesis/mechanisms explaining the same phenomenon
- When two different mechanisms can reproduce the same phenomenon, how can modeling help to distinguish between these mechanisms?

Description:

- Introduce problem and provide examples:
 - multiple mechanism, same result
- Introduce CPM/PDE hybrid/multiscale models
 - coupling model formalisms (through production + chemotaxis)
- Introduce vasculogenesis
 - Isolated cells into vascular network
- Provide two models: A.xml and B.xml that show the same behavior
- Assignment 1: What biological processes do these models reflect?
 - Autocrine model: angioblasts produce their own chemoattractant (VEGF)
 - Paracrine model: paracrine chemoattractant is bound to angioblasts-produced matrix molecules
- Assignment 2: How can you determine which one is more plausible?
 - Theoretically?
 - Explore differences in parameter sensitivity:
 - Sensitivity analysis: ParamSweep (see "[parameter sweep](#)" in FAQ)
 - Experimentally?
 - Explore how the models produce different predictions:
 - Inhibit VEGF binding (use nonbinding isoform VEGF121)
 - Change cell densities
 - Administer fluorescent VEGF
 - Quantitative analysis?
 - Quantify parameters:
 - FRAP: diffusion
 - FRAP: rate of binding/unbinding
 - ELISA: decay
 - Microfluidic device: chemotactic strength

Paper:

- Köhn-Luque A, de Back W, Starruß J, Mattiotti A, Deutsch A, J-M Perez-Pomares, HA Hererro. (2011) Early Embryonic Vascular Patterning by Matrix-Mediated Paracrine Signalling: A Mathematical Model Study. PLoS ONE 6(9): e24175. [link](#)

Documents:

- [Assignment \(handout, pdf\)](#)
- [Diff \(handout, pdf\)](#)

Morpheus models:

- [Example: Vascular patterning](#)
- [h A.xml \(autocrine chemotaxis\)|h](#)

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- h B.xml (paracrine chemotaxis)|h

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From:

<https://imc.zih.tu-dresden.de/wiki/morpheus/> - **Morpheus**

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Last update: **15:52 21.12.2012**

