Module 4: Vascular Patterning

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Aim:

- Learn to distinguish between alternative hypothesis/mechanisms explaning 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 nonbindnig isoform VEGF121)
      - Change cell densities
      - Administer fluorescent VEGF
  - Quantitative analysis?
    - Quantify parameters:
      - FRAP: diffusion
      - FRAP: rate of binding/unbindung
      - 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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