

Instruction Guide for Renal Medulla Model

Note: the modules are constructed using COMSOL Multiphysics 5.3 (COMSOL, Burlington, MA). To run the modules, COMSOL Multiphysics 5.3 or higher versions are required.

Details of the model and baseline parameter values can be found in Ref (1).

Top-level modules

1. Set the parameter values in “Parameters” under “Global Definitions”
2. Select “Auxiliary Analysis” from the “Study” tab, and click “Compute”
3. Once complete, select “Initial Conditions for Flow Models” from the “Study” tab, and click “Compute”
4. Once complete, select “Flow” from the “Study” tab, and click “Compute”
5. Once complete, select “O₂ – No Shunting” from the “Study” tab, and click “Compute”
6. Once complete, select “O₂ – Shunting” from the “Study” tab, and click “Compute”
7. Simulation complete. View the results under “Results”.
8. Extract PO₂ values at $x = [8, 6.8, 5, 3, 1]$ (mm), which correspond to mid-section of OSOM, ISOM, IM1, IM2 and IM3, respectively. These values will be used as input parameter values for low-level modules.

Low-level modules (common procedure for all low-level modules)

1. Set the parameter values in “Parameters” under “Global Definitions”
2. Select “Study 1” from the “Study” tab, and click “Compute”
3. Simulation complete. View the results under “Results”. Average tissue PO₂ can be found in “Derived Values” under “Results”.

Specific procedure for IM1 and IM2 low-level modules

1. To simulate for IM1 (upper-inner medulla), enable “CD”, “VO₂”, and “Capillary Source” under “Transport of Diluted Species”, and disable “CD 1”, “VO₂ 1”, and “Capillary Source 1”. Ensure the parameter values are set for IM1.
2. To simulate for IM2 (mid-inner medulla), enable “CD 1”, “VO₂ 1”, and “Capillary Source 1”, and disable “CD”, “VO₂”, and “Capillary Source”. Ensure the parameter values are set for IM2.

Reference

1. **Lee CJ, Gardiner BS, Evans RG, and Smith DW.** A model of oxygen transport in the rat renal medulla. *Am J Physiol Renal Physiol* 315: F1787-F1811, 2018.