A 3D electron microscopy segmentation pipeline for hyper-realistic diffusion simulations

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• problem: diffusion MRI lacks specificity to tissue features, e.g. myelination
• goal: identify signature MRI signal components specific to tissue compartments
• approach: hyper-realistic simulations based on microscopy data
  • essence of microstructure => MRI signal relation
  • flexibility to manipulate the model

results

myelinated axon segmentation

whole axon segmentation

myelin sheath separation

3D EM data acquisition (Gatan 3View)

pixel classification (Ilastik2)

axon classification (Neuroproof4)

conclusion

• we have developed a method for segmenting large 3D electron microscopy datasets of the white matter
  • minimal manual intervention, yet still fairly laborious
• remaining issues:
  • complex myelin loops
  • split/merge errors automated segmentation
• utility:
  • flexible mesh models for realistic simulations of diffusion MRI
  • informative benchmark statistics of tissue microstructure
  • a way to robustly quantify subtle changes in myelination

methods

background

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