Unveiling the Brain's Highways: Automated Quantification of Axonal Density

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-1- Rationale

► Understanding how brain regions connect is crucial for neuroscience.

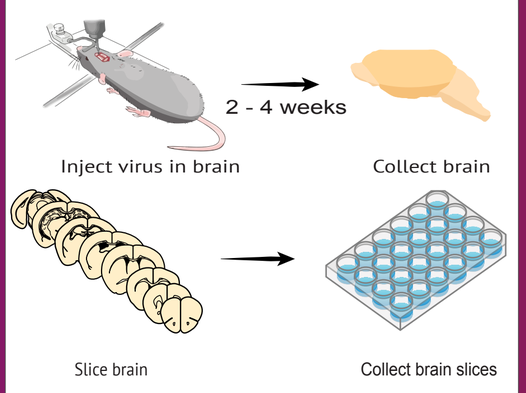
► Axonal innervation, a measure of axonal projection, is a key metric, but current methods for quantification result in variability or are costly.

► **How can one develop a standardized protocol to quantify axonal projections, which are essential for understanding how the brain is wired? Here, we specifically look to quantify projections that are pain-active.**

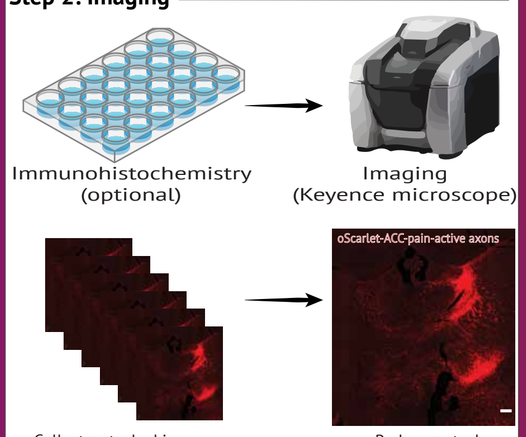
► AxoDen, a novel, open-source algorithm, that offers a standarized analysis.

-2- Workflow

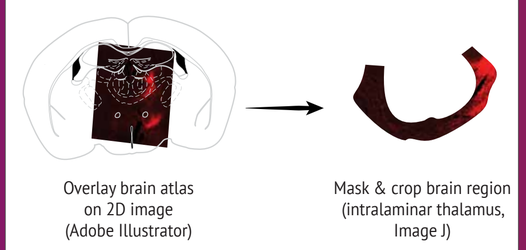
Step 1: Animal preparation and tissue collection



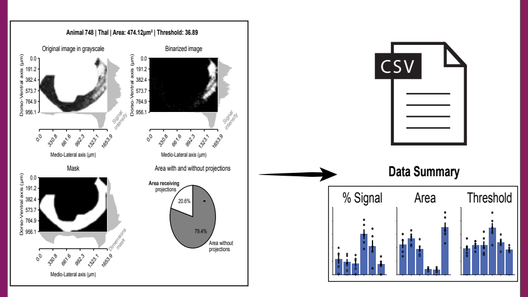
Step 2: Imaging



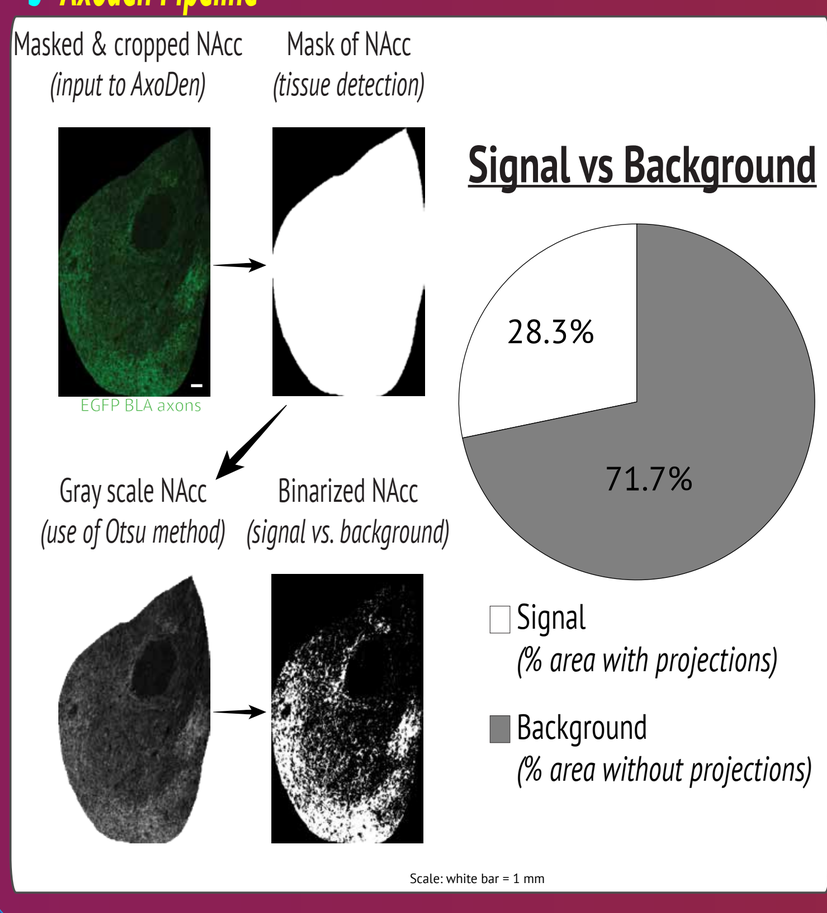
Step 3: Image pre-processing



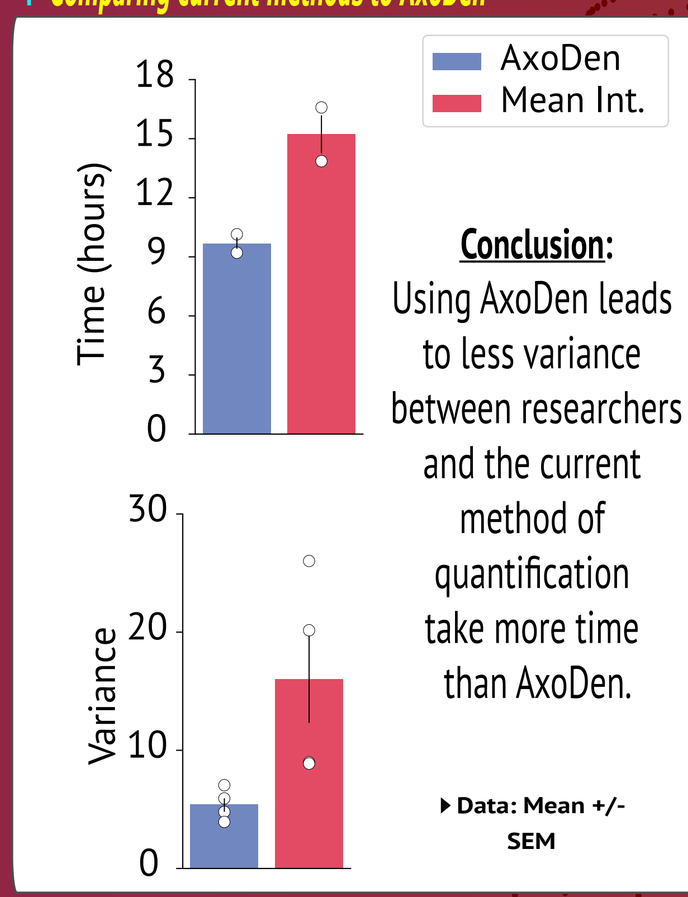
Step 4: Quantification with AxoDen



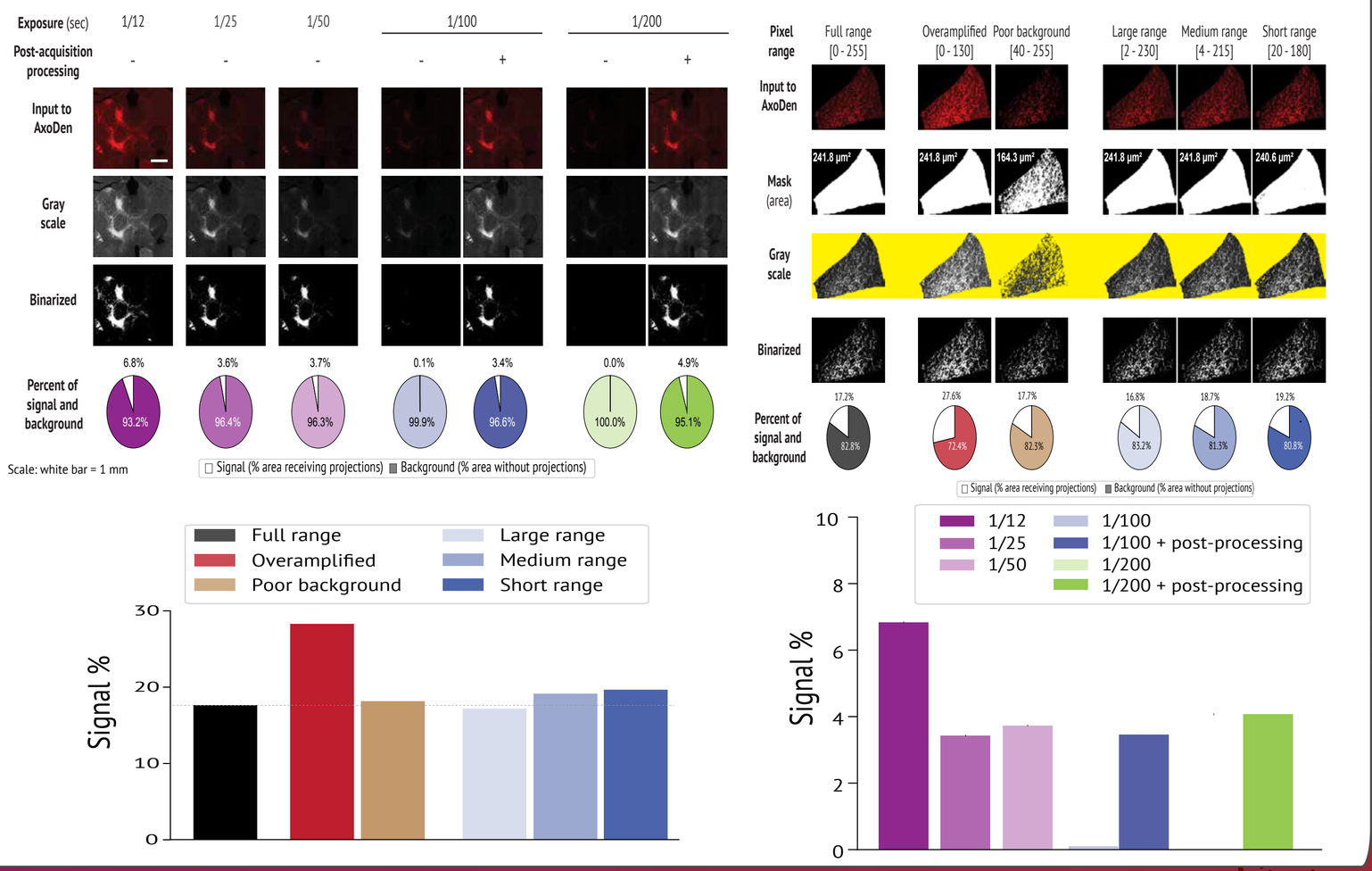
-3- Axoden Pipeline



-4- Comparing current methods to AxoDen



-5- Testing the Robustness of AxoDen

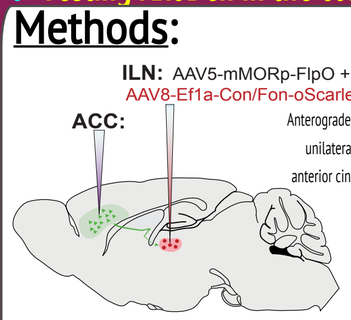


-6- Testing AxoDen in the context of pain active neurons

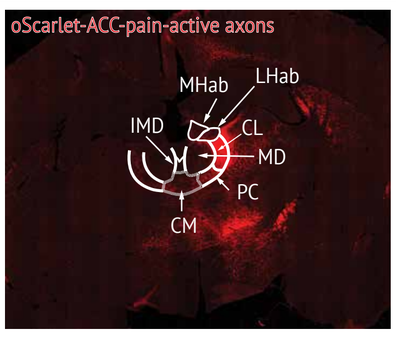
Methods:

ILN: AAV5-mMORp-FlpO + AAV8-Ef1a-Con/Fon-oScarlet

ACC: Anterograde virus injected unilaterally in right anterior cingulate cortex



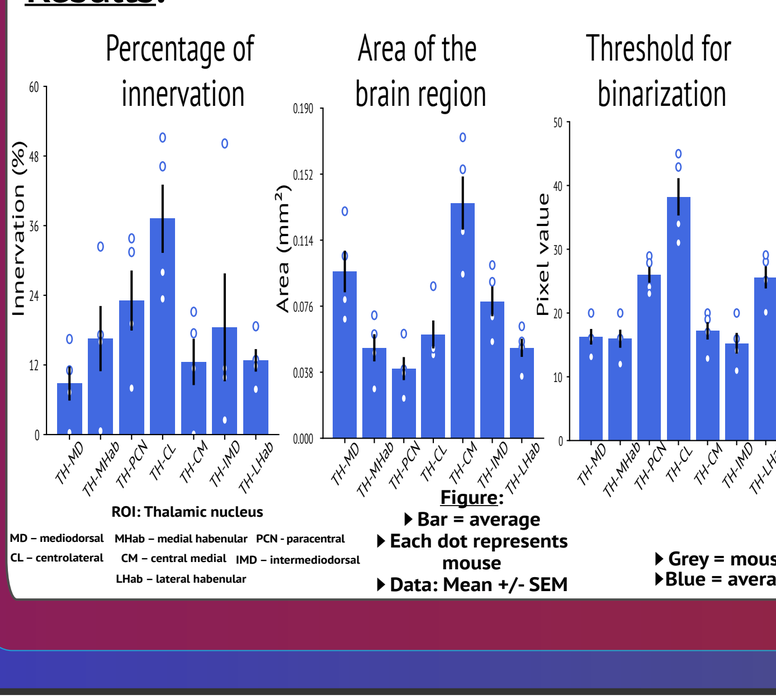
CAG Sun1: TRAP2 mice

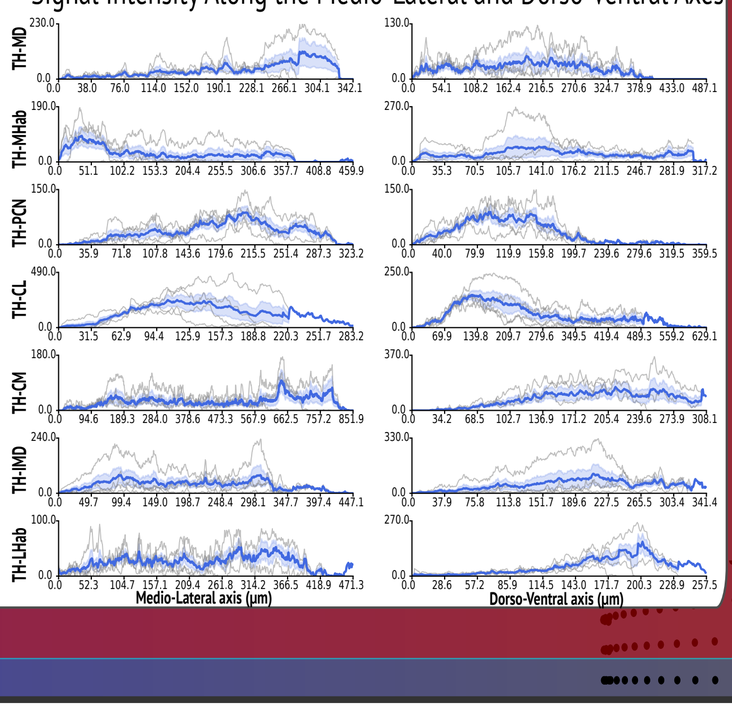


Conclusions:

- The CL of the thalamus recieves the most innervation of pain-active mu-opioid-receptor-expressing neurons in ACC.
- The CL of has the highest threshold of binarization de-spite covering a small area of the brain. (TH)
- The CL may serve as a central hub for information processing or relaying, due to its extensive connections

Results:





-7- Conclusions

Axoden provides a large range of benefits:

- Faster Analysis: Saves valuable research time.
- Enhanced objectivity: Reduces inter-researcher varability.
- Accurate Data: Delivers reliable measurements.
- Acessibility: Freely available for all researchers. (http://axoden.streamlit.app)
- Axoden empowers researchers to unlock new frontiers in brain connectivity mapping.

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-8- Next Steps

- Publish the manuscript to eNeuro Journal.

Access Github respositiory here:

GitHub

-9- References

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