

Reinforcement
learning

RL + Tractographie = 

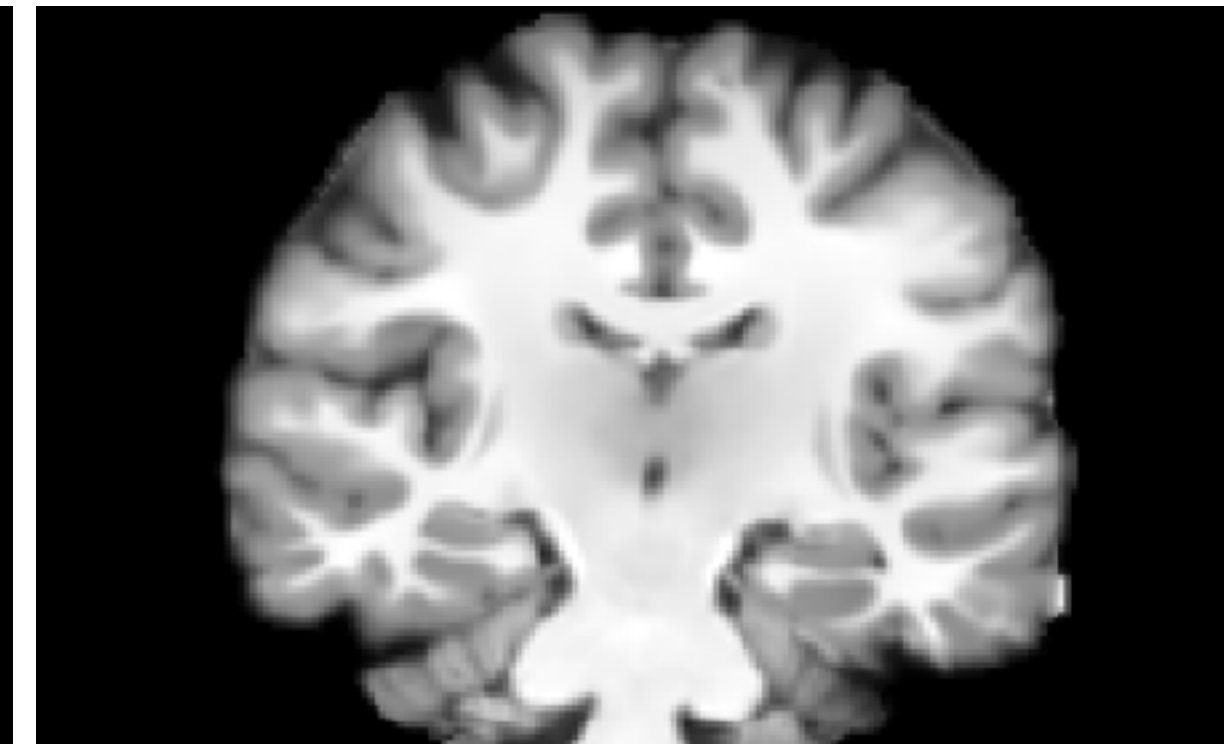
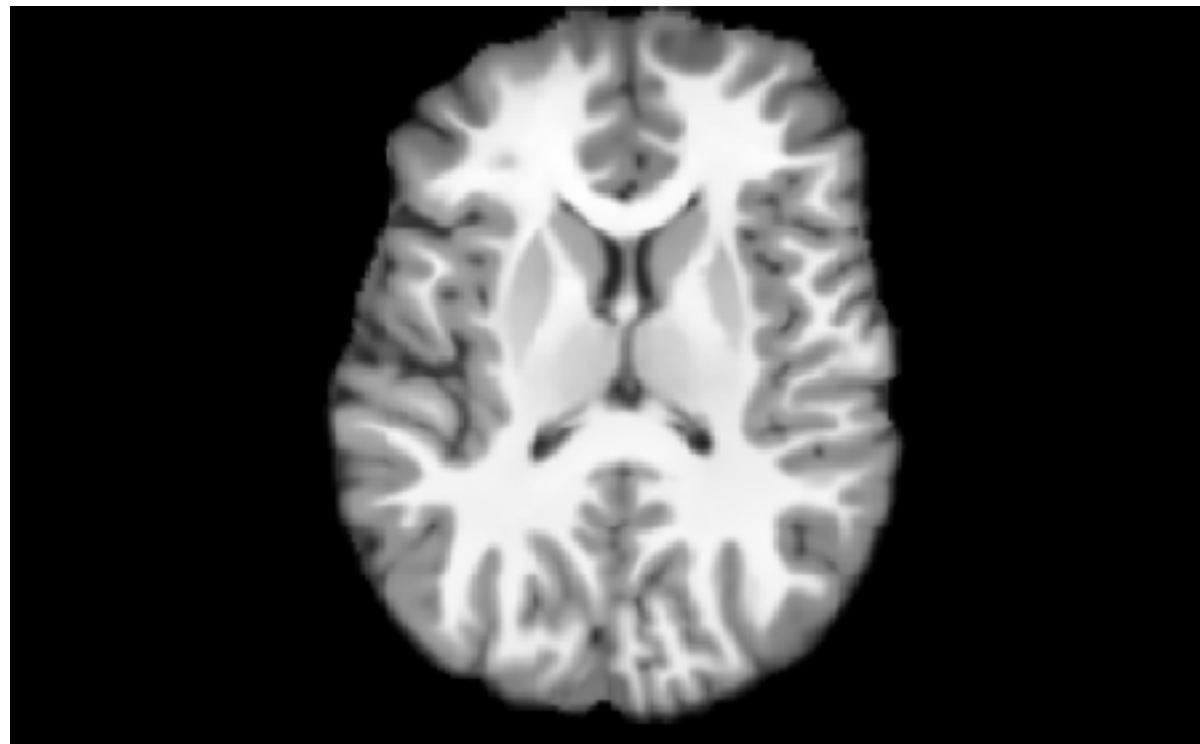
Journée scientifique AIM-CIMUS 2025

Jeremi Levesque - Jan 22 2025

Imagerie du cerveau

Dans le cerveau on a:

1. Matière grise
2. Liquide cérébro-spinal
3. Matière blanche

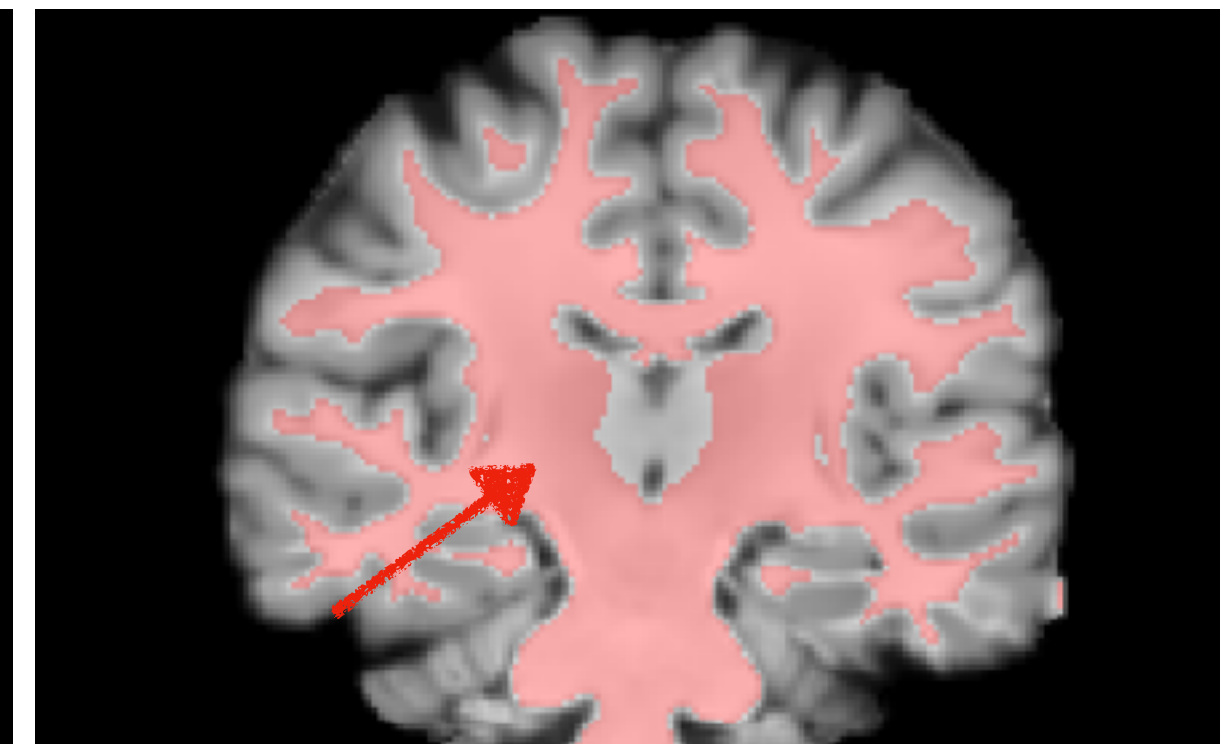
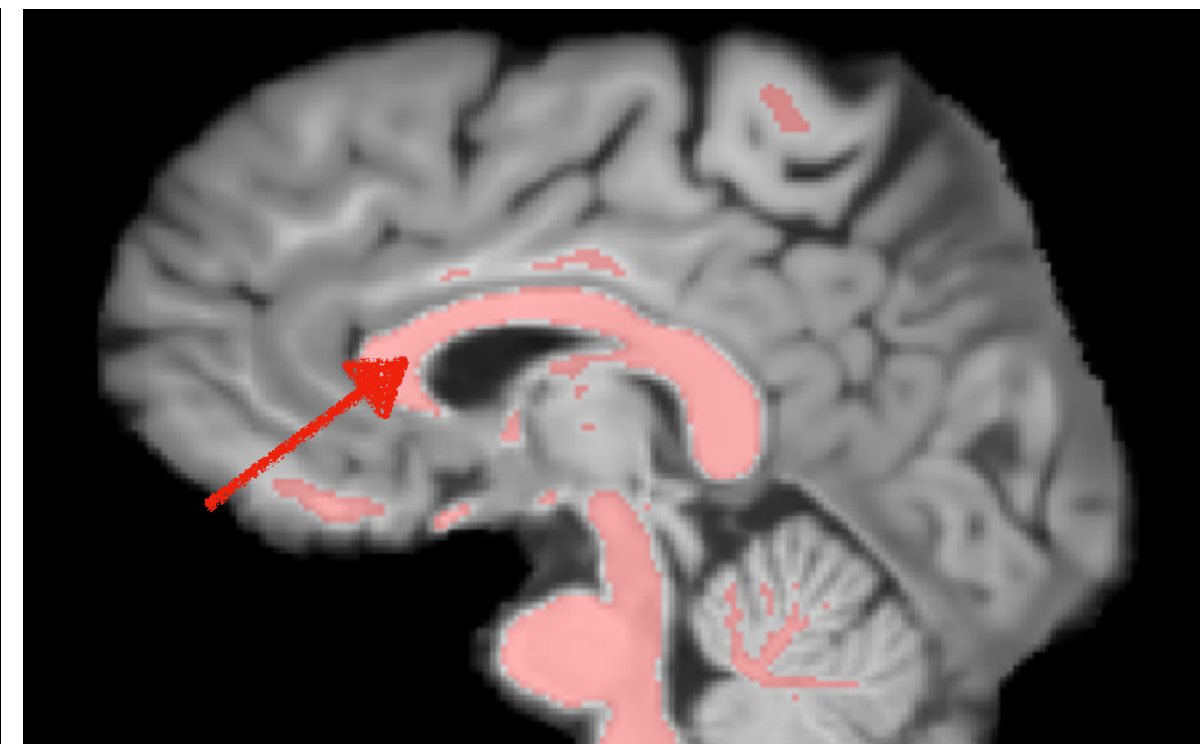
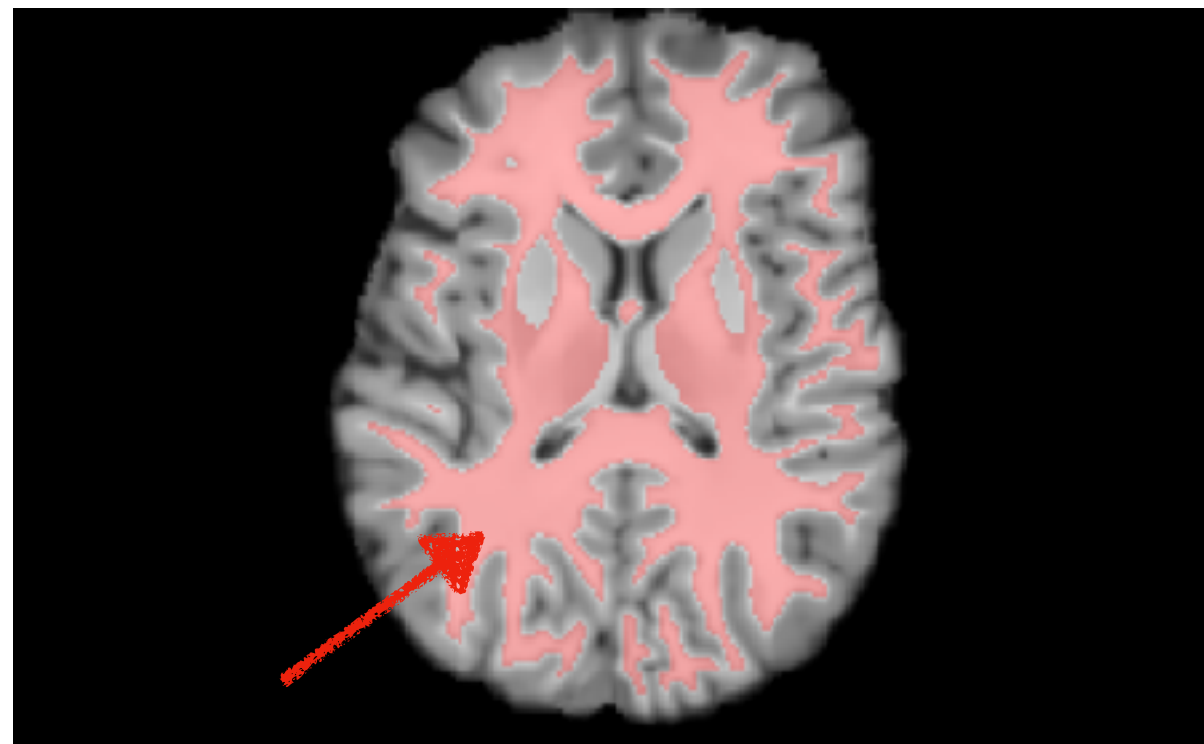


Imagerie du cerveau

Dans le cerveau on a:

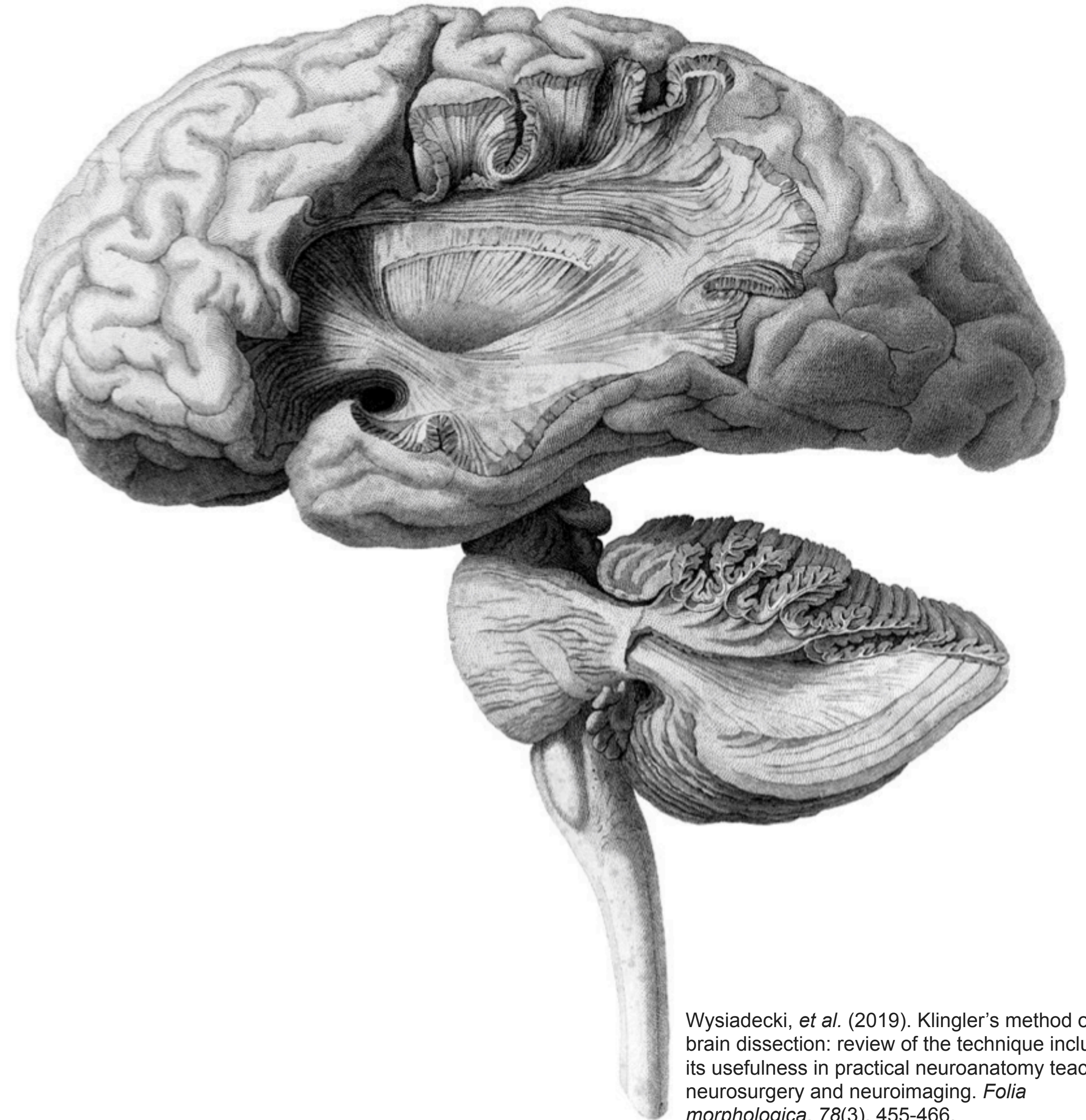
1. Matière grise
2. Liquide cérébro-spinal
- 3. Matière blanche**

← Ce qui m'intéresse

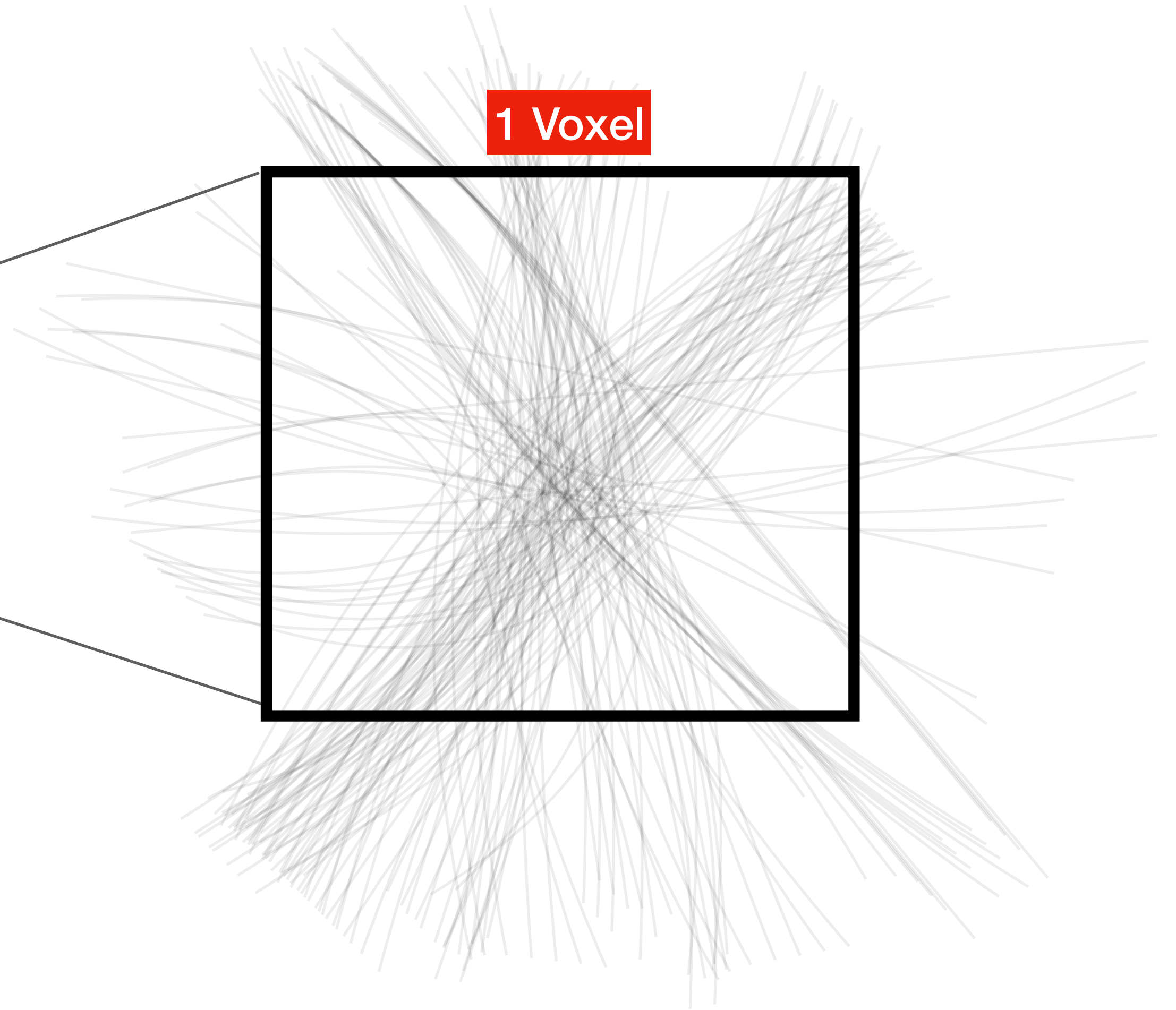
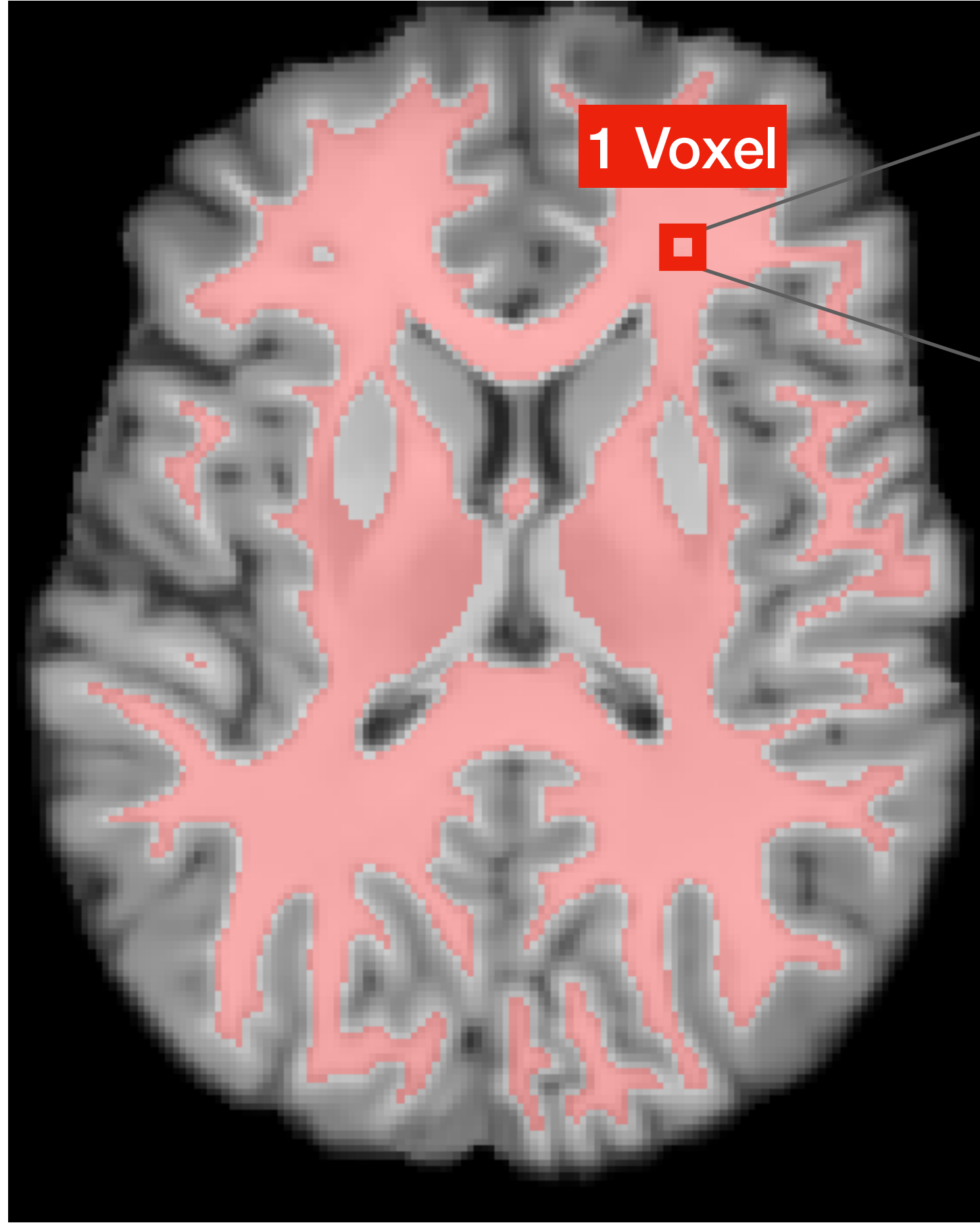


Matière blanche

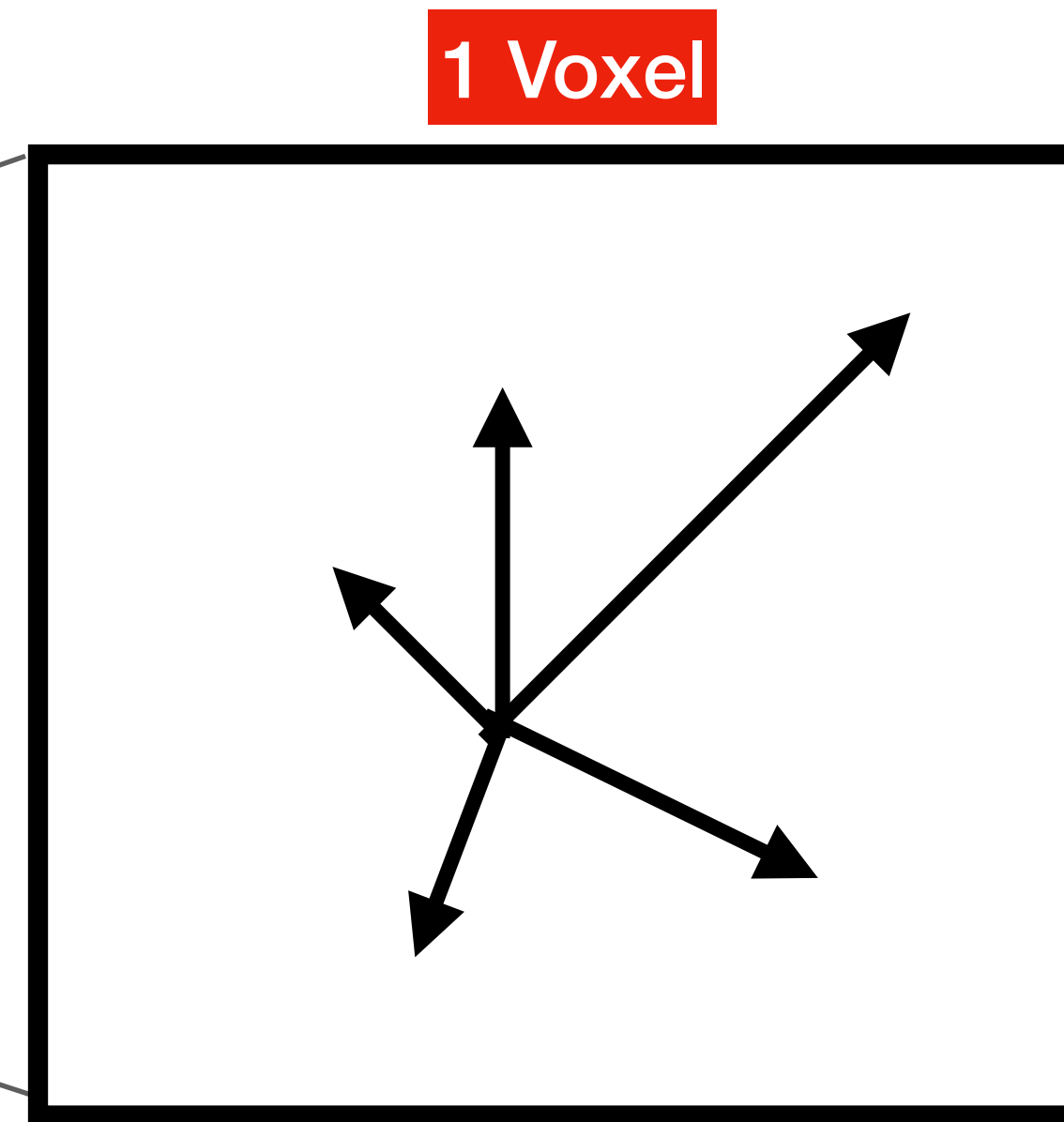
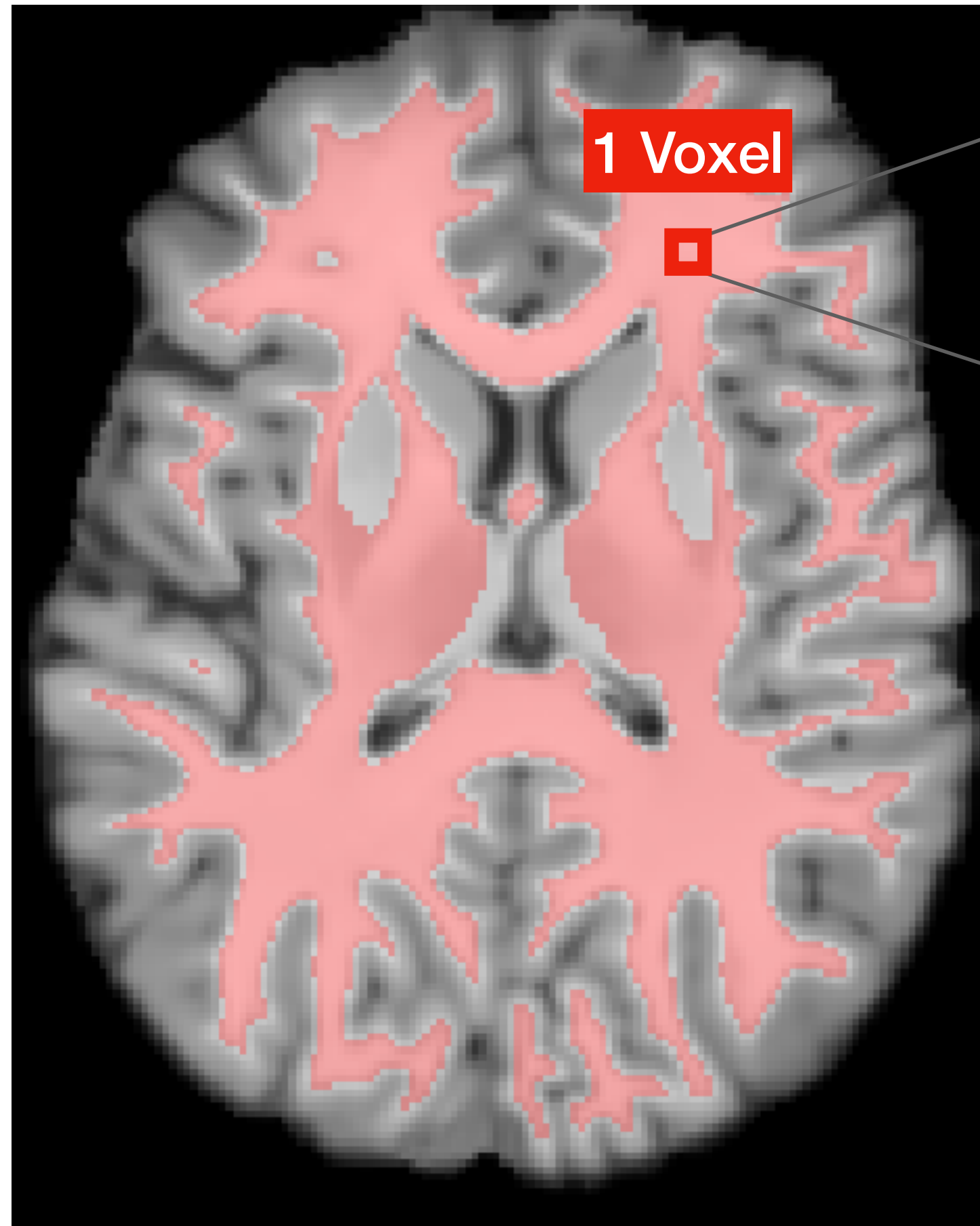
- Composée d'**axones**
- Chaque axone **connecte** deux régions différentes de la matière grise
- Axones de 0.2-20 μ m (impossible à voir de façon non-invasive)

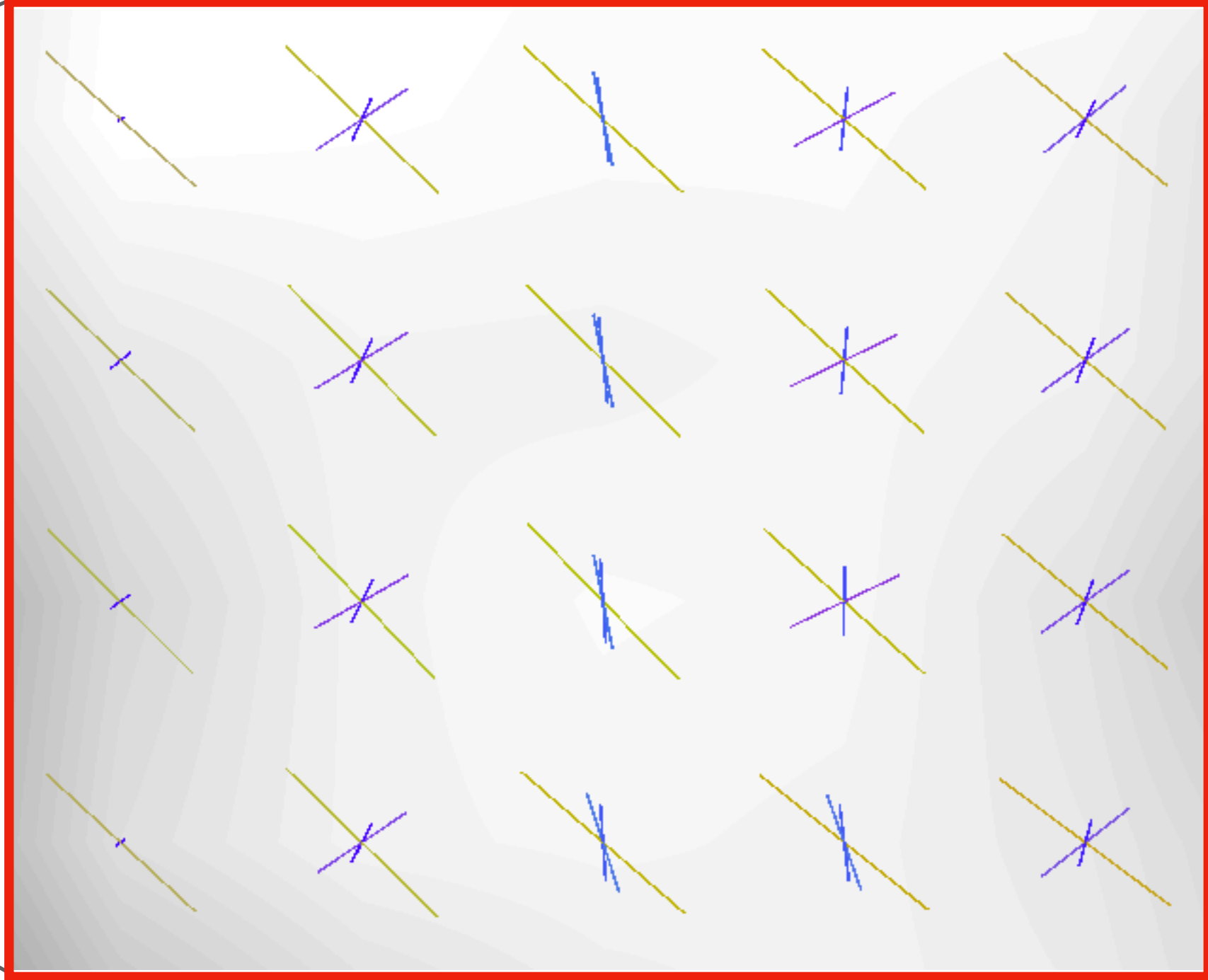
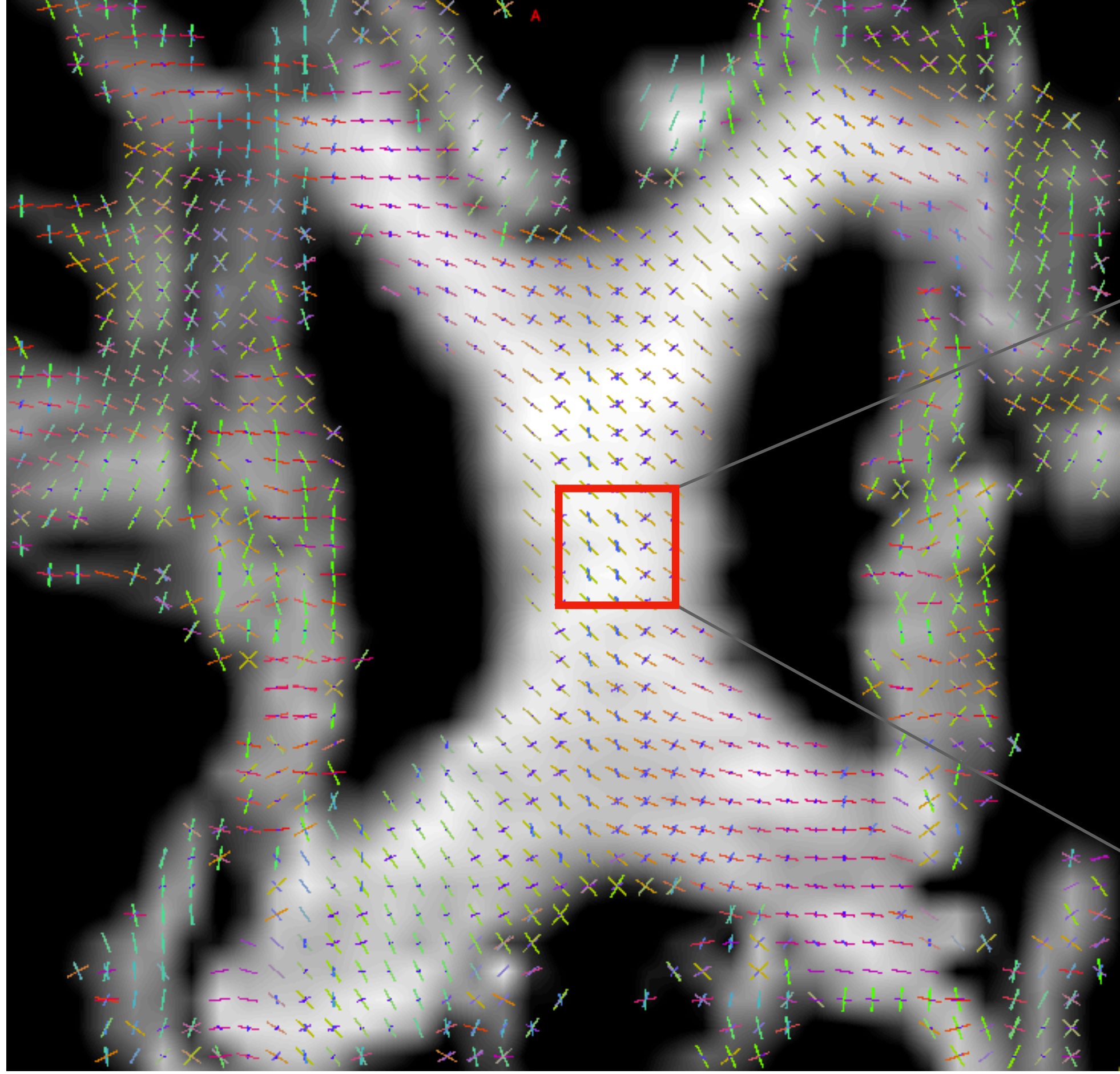


Wysiadecki, *et al.* (2019). Klingler's method of brain dissection: review of the technique including its usefulness in practical neuroanatomy teaching, neurosurgery and neuroimaging. *Folia morphologica*, 78(3), 455-466.

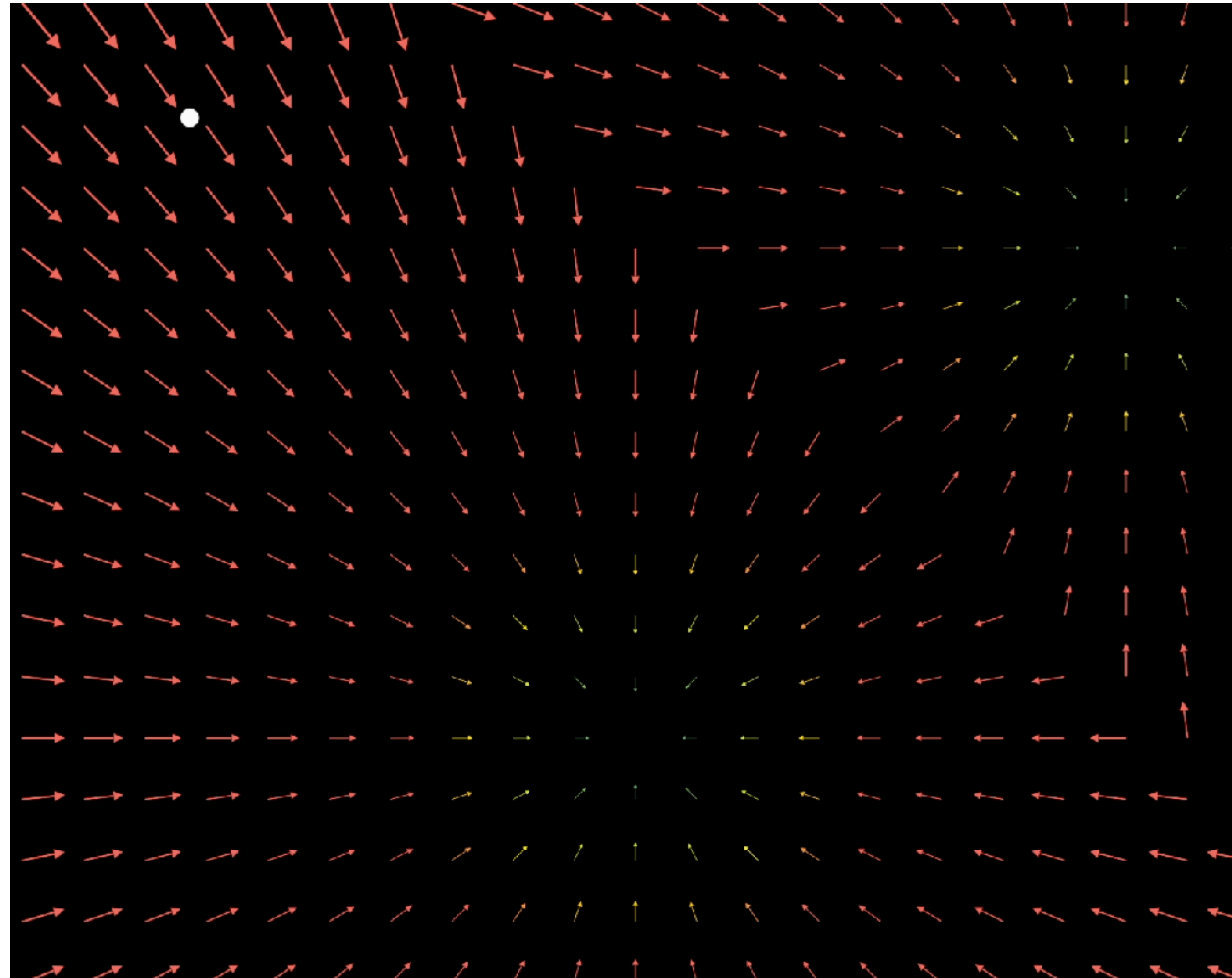


IRM de diffusion!



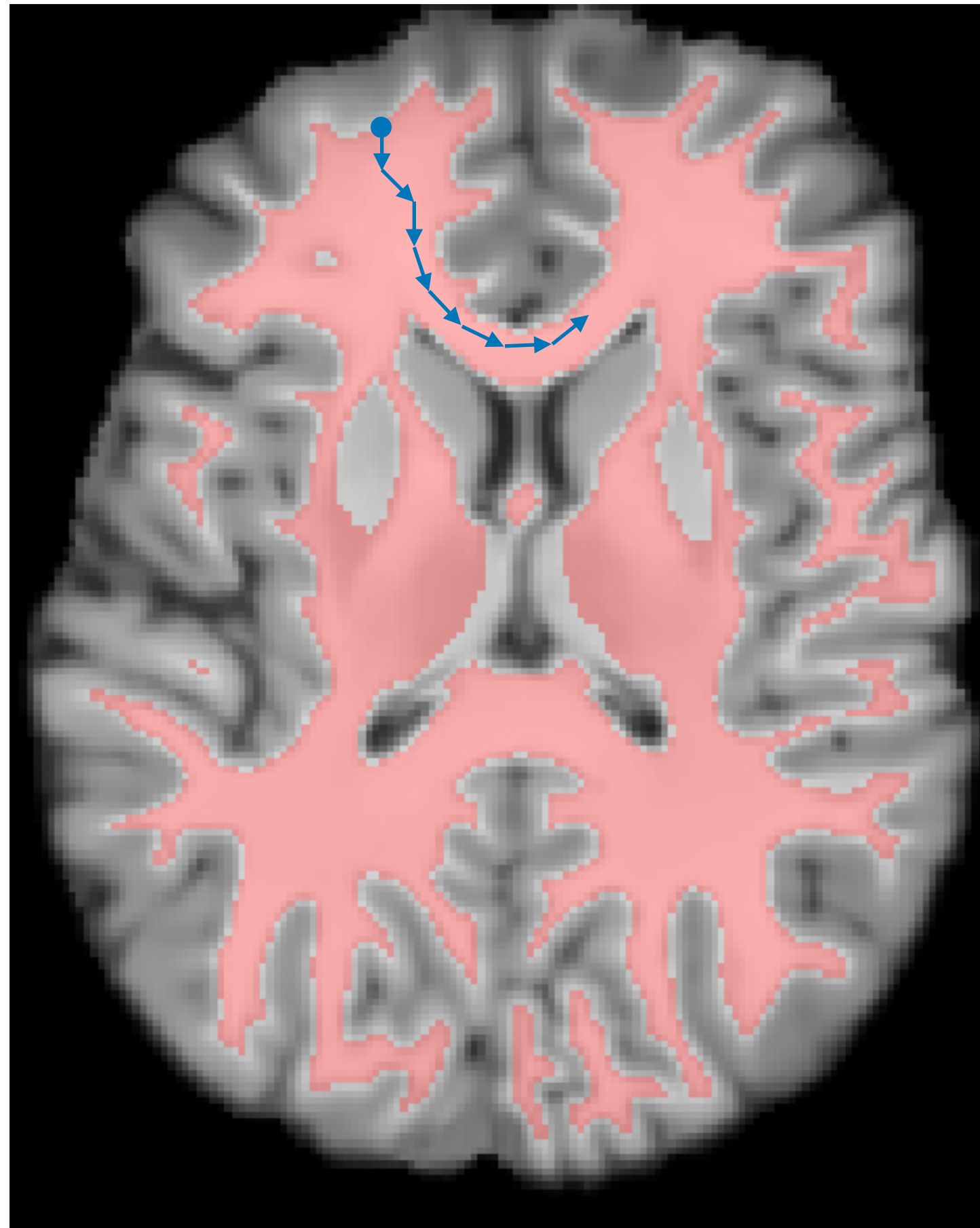


(Parenthèse) Échantillonner une trajectoire

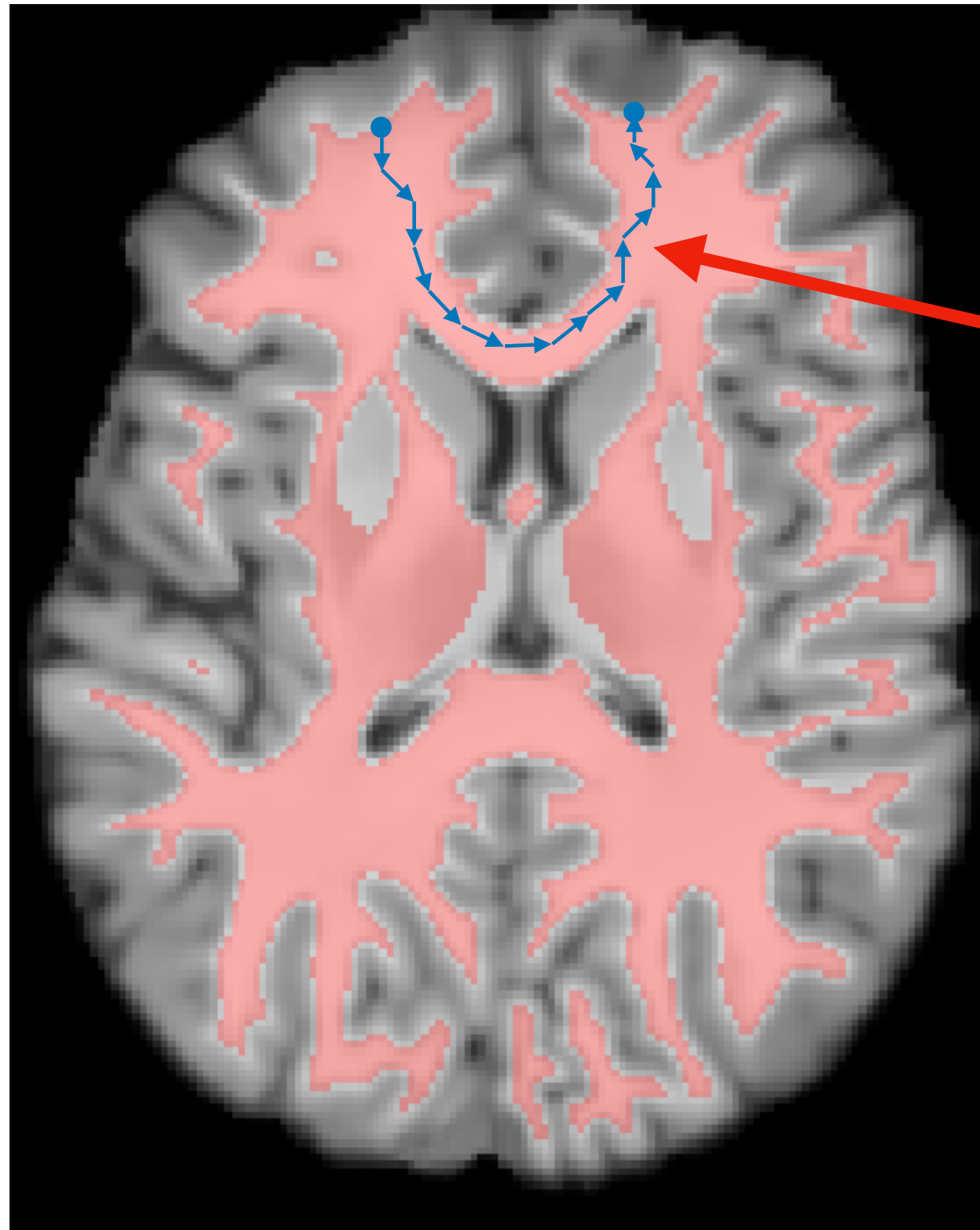


Animation: Outlier (2024). *Diffusion networks from scratch*. Youtube.

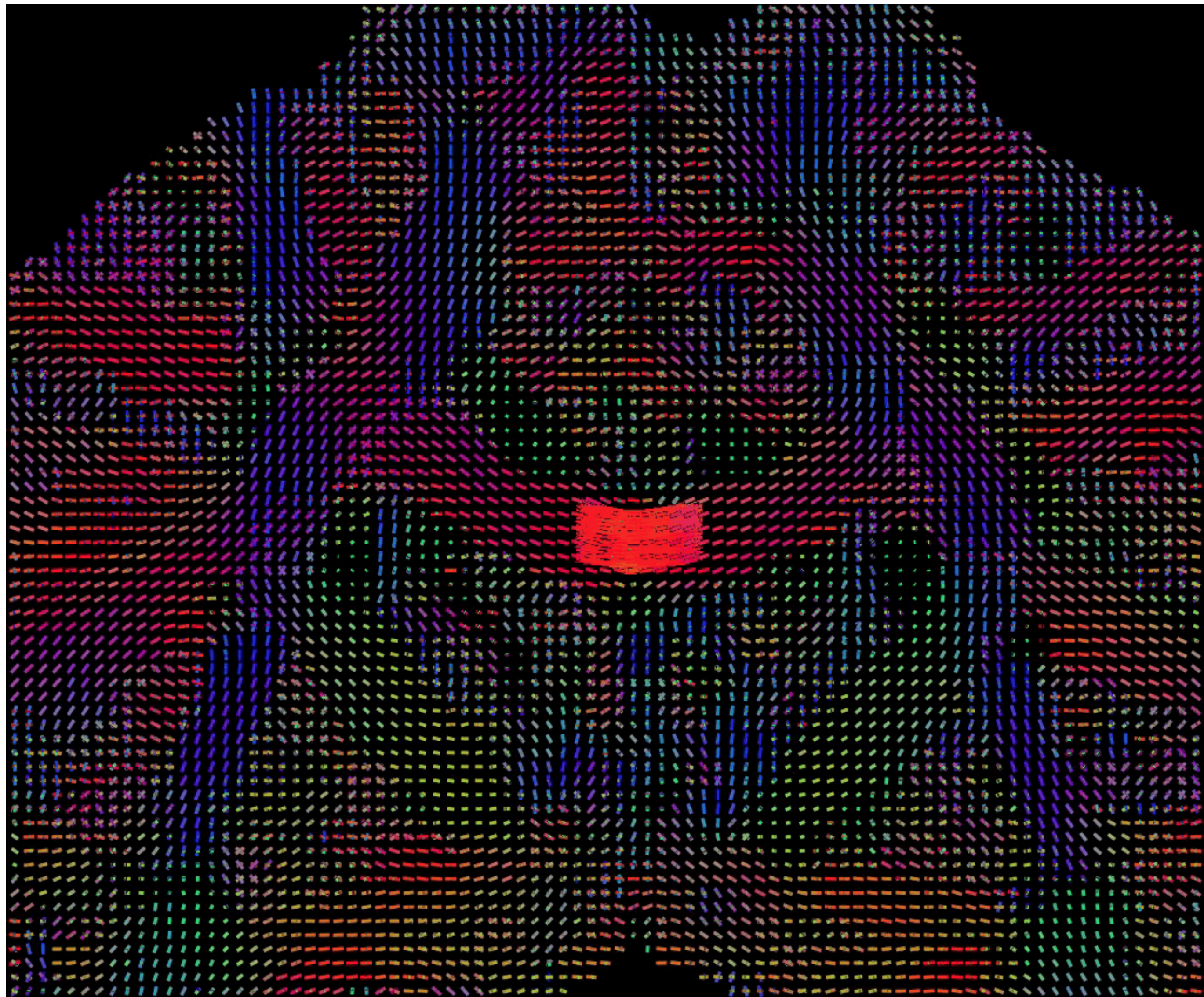
Tractographie



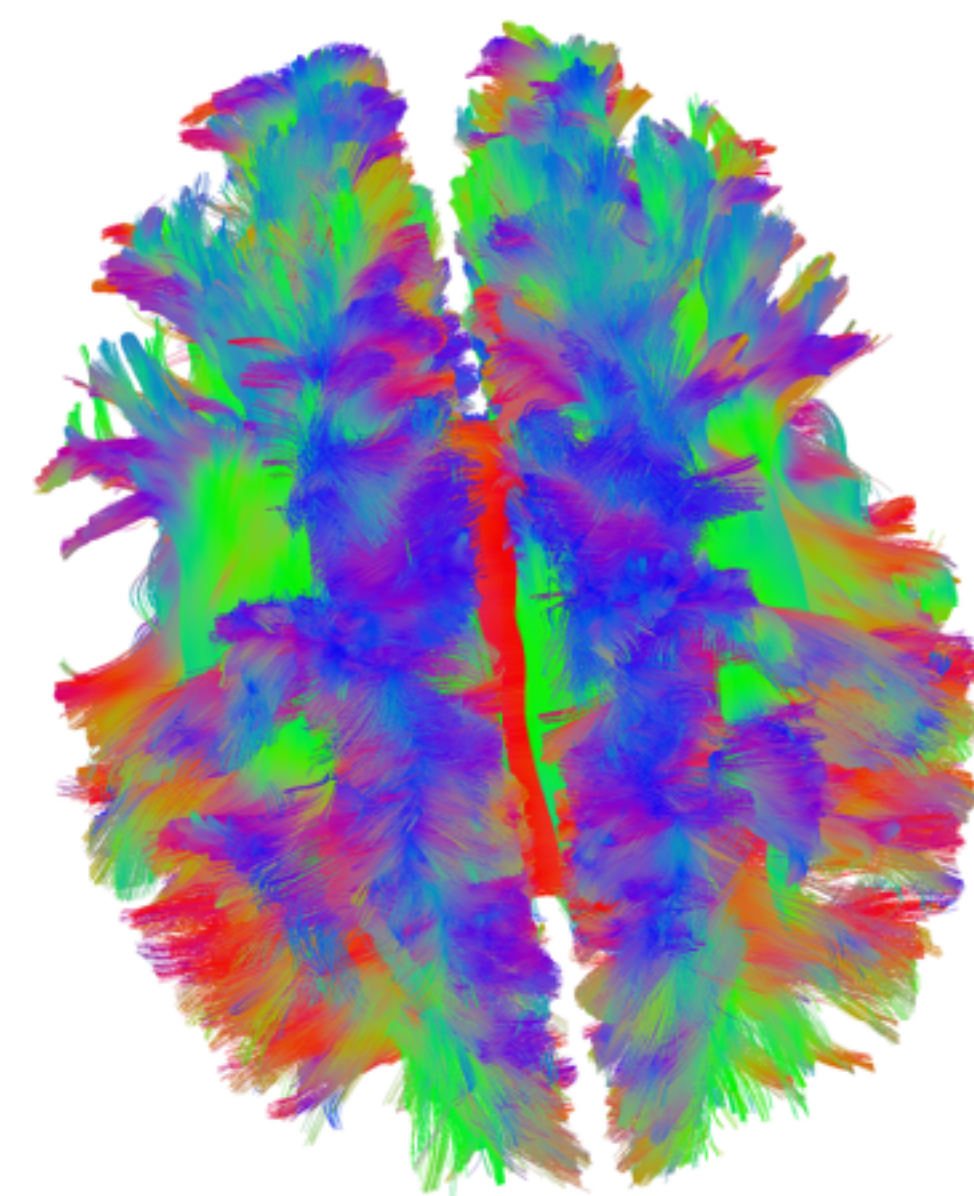
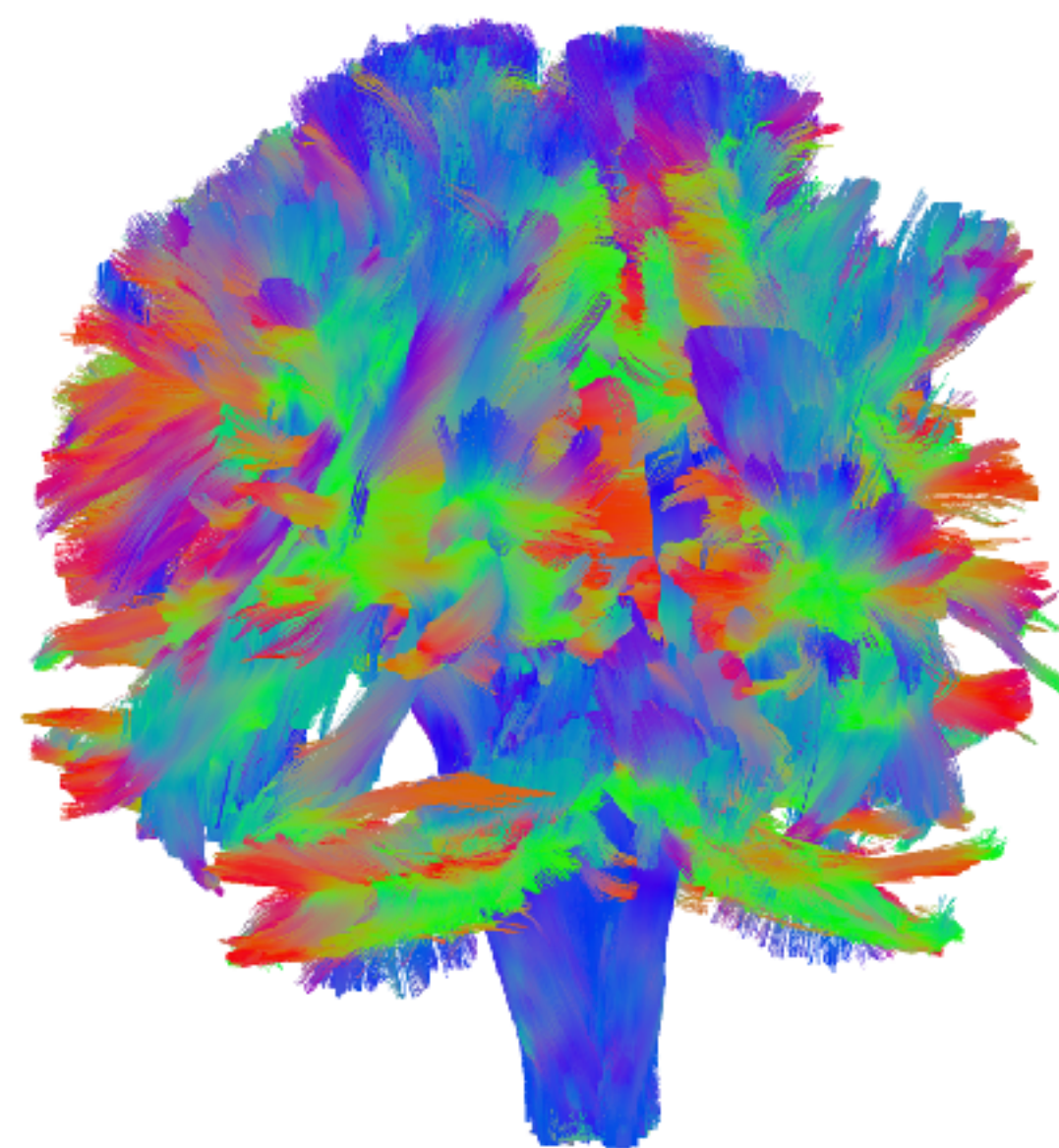
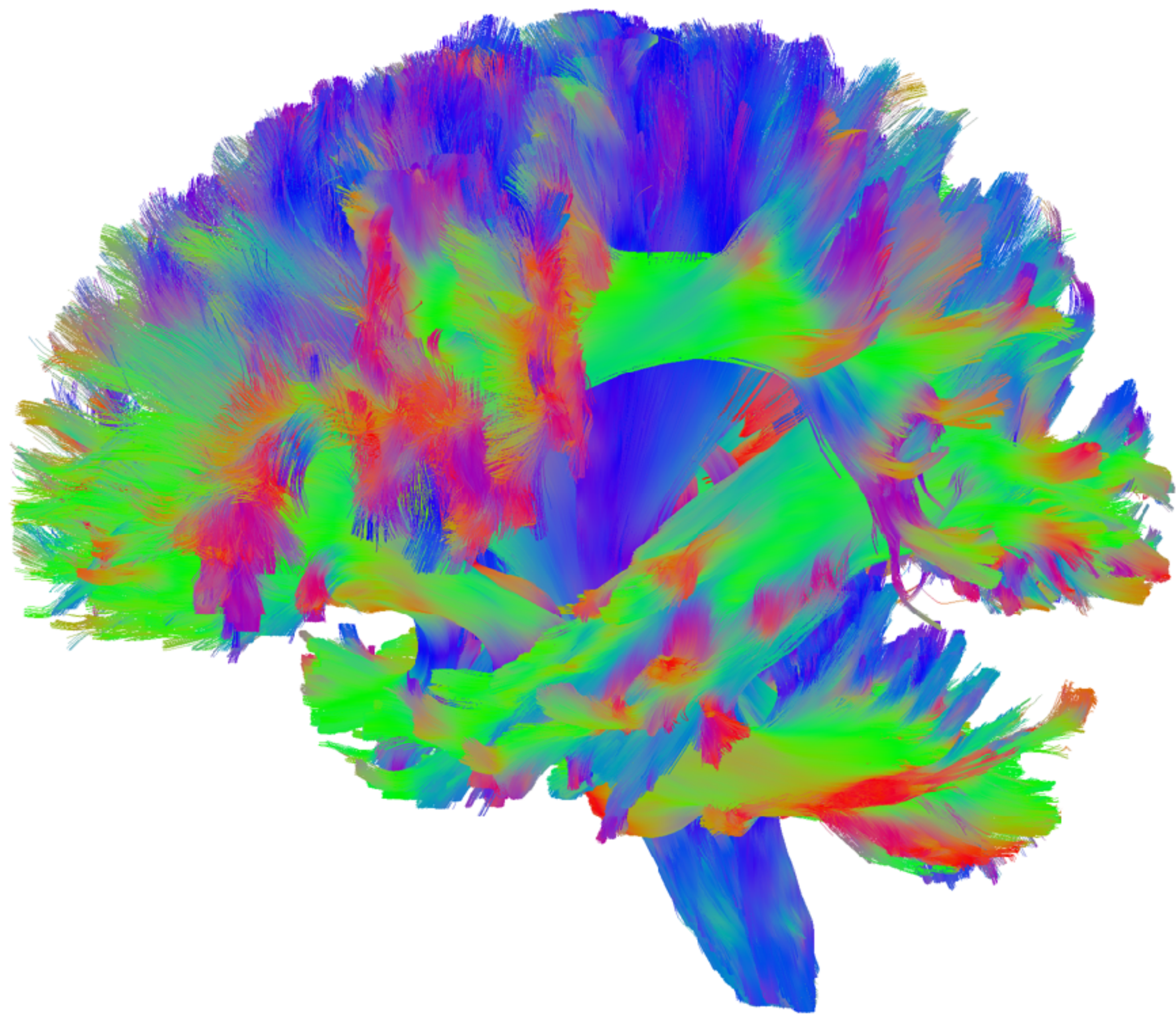
Tractographie



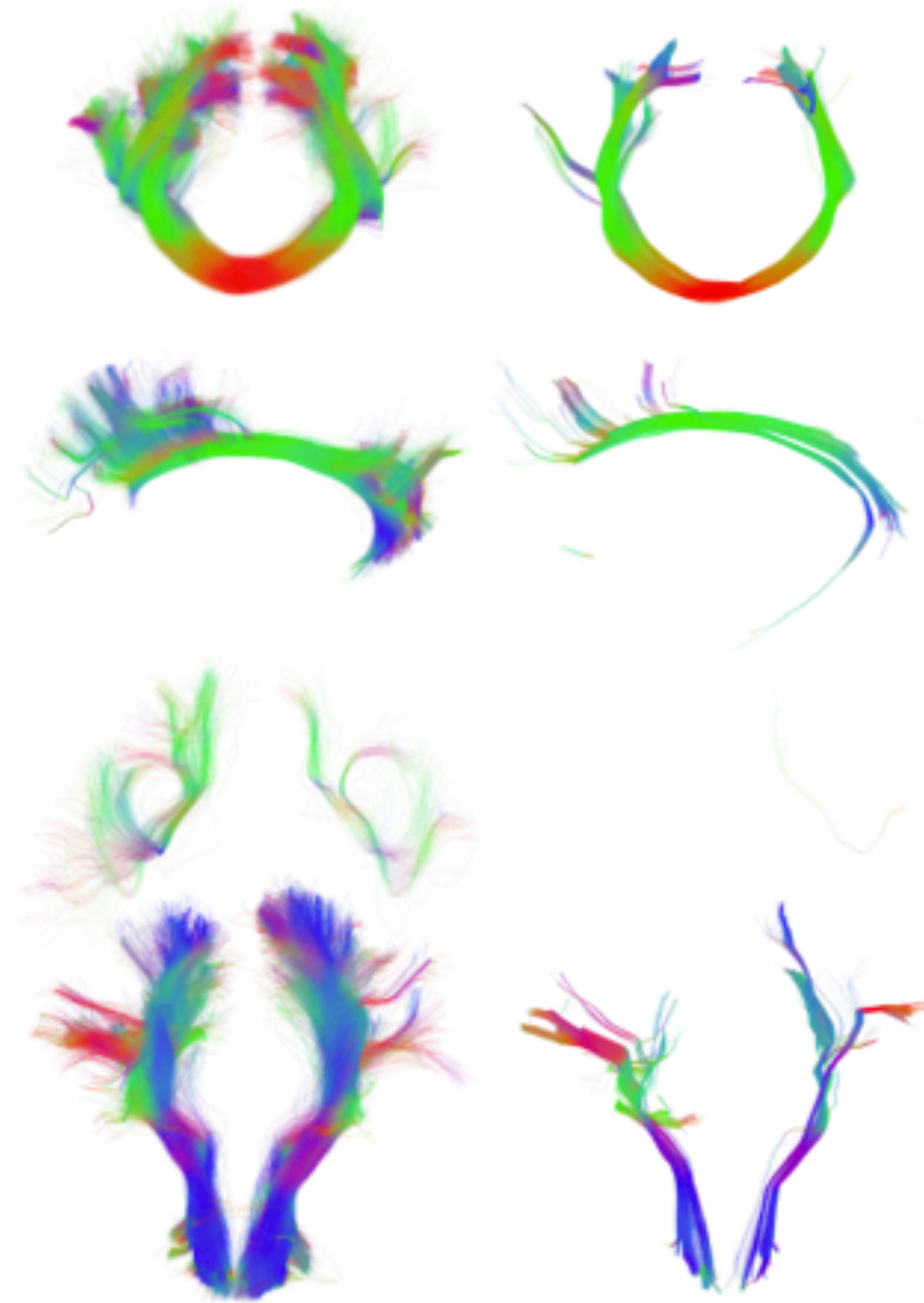
On a approximé d'une axone!



Crédit: Gabriel Girard



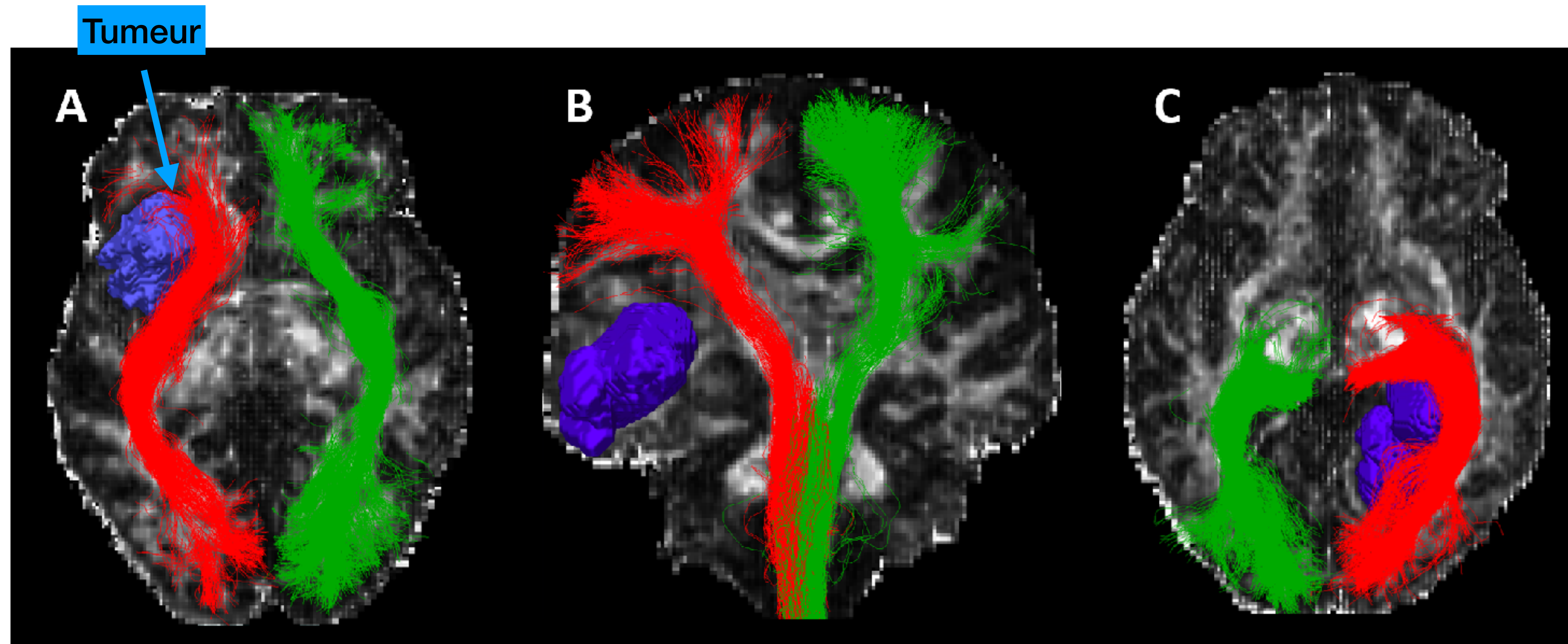
Résultats des méthodes classiques



Référence

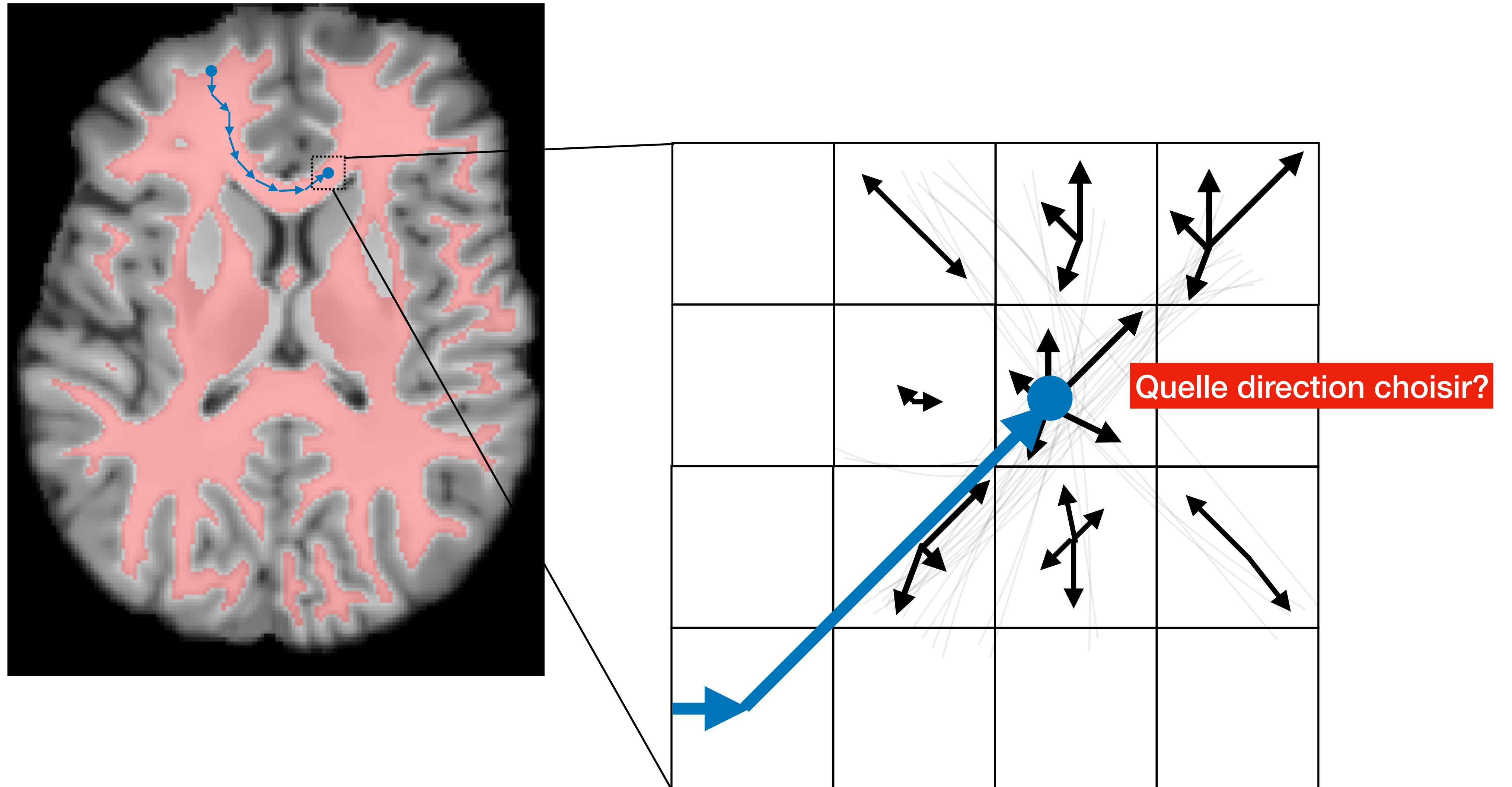
sd_stream

Pourquoi la tractographie?



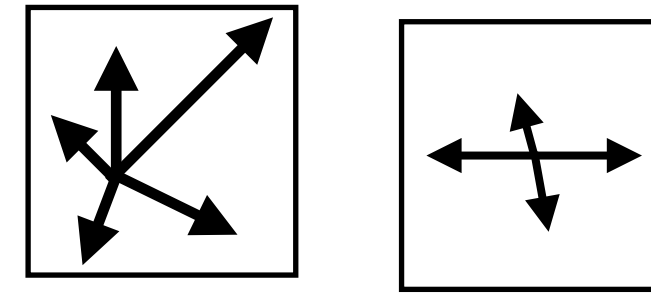
Crédit: SCIL

Les problèmes

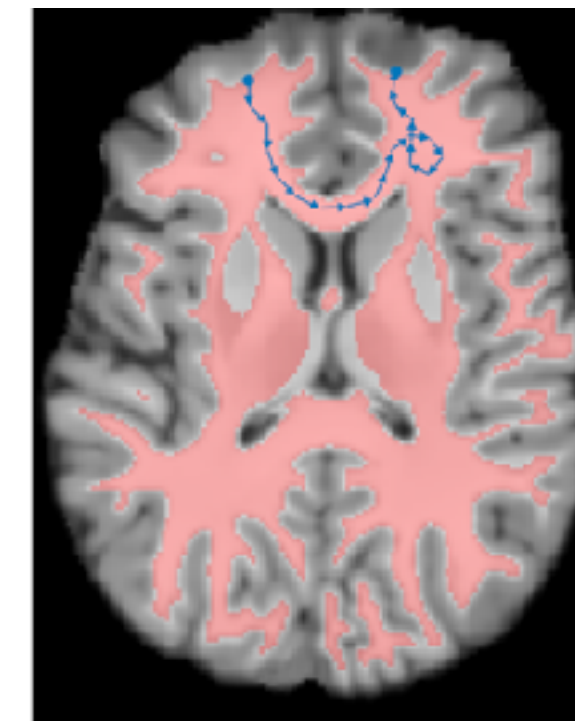


Les problèmes

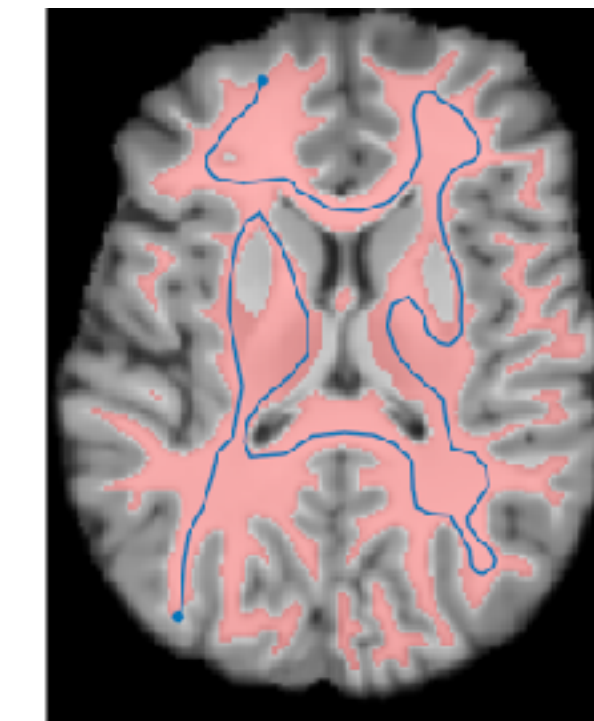
- Quelle direction choisir à chaque pas?



- Beaucoup de reconstructions **invalides**.

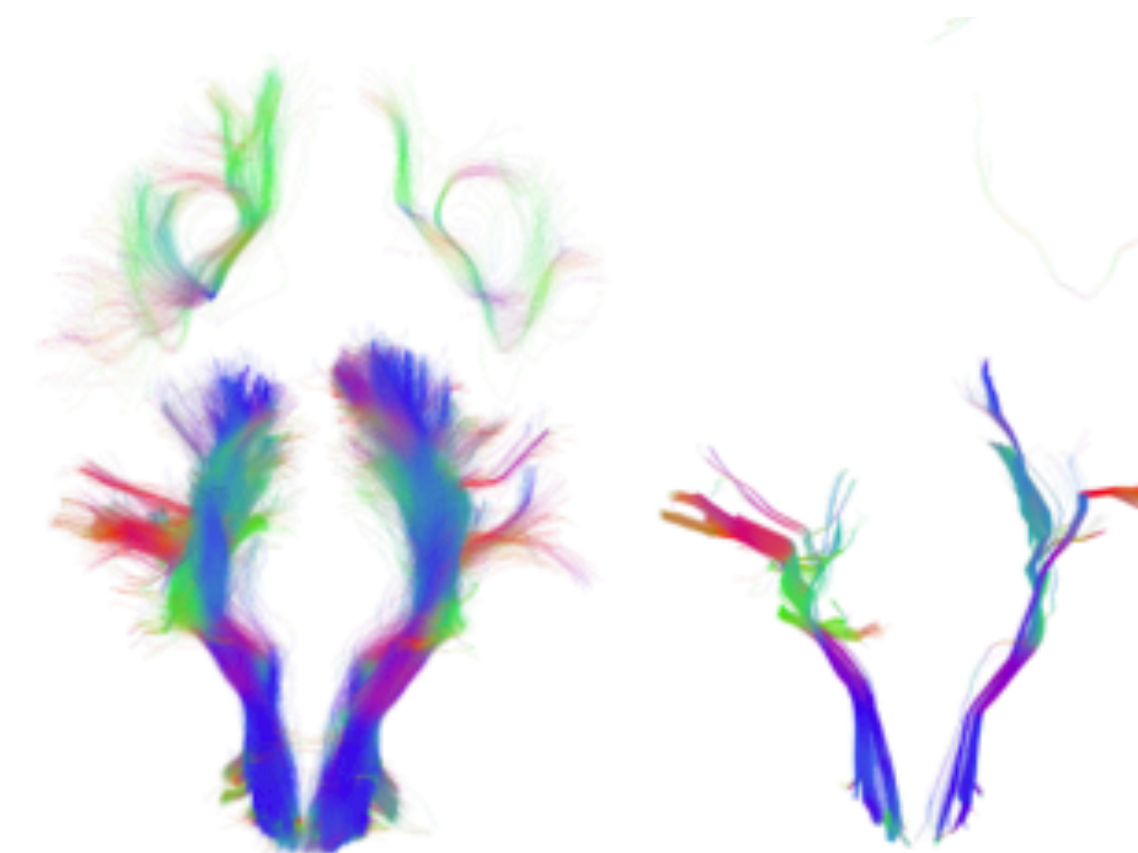


Boucle



Anatomiquement invalide

- Régions **non ou peu reconstruites**.



Apprentissage par renforcement (RL)

Bonnes actions



Mauvaises actions



Apprentissage par renforcement (RL)

- Permet d'entraîner un agent à prendre plusieurs **décisions** une à la suite de l'autre.
- Apprends en **interagissant avec l'environnement** de façon **autonome**.
- Apprends à **maximiser** ses récompenses.

ChatGPT



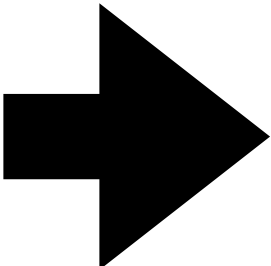
Apprentissage par renforcement → Meilleures réponses!

AlphaGo

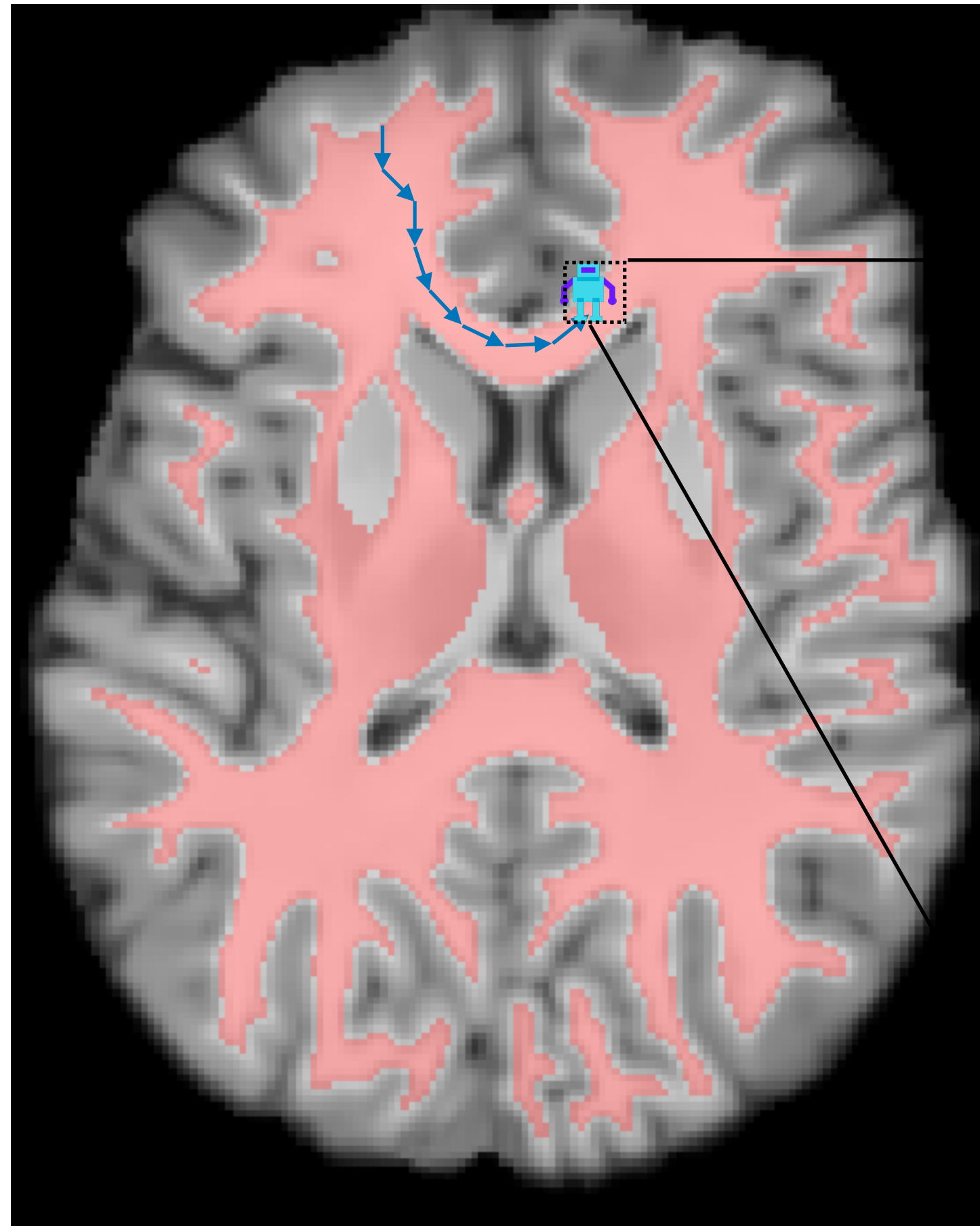


Apprentissage par renforcement → **Nouvelles stratégies!**

RL + Tractographie = 

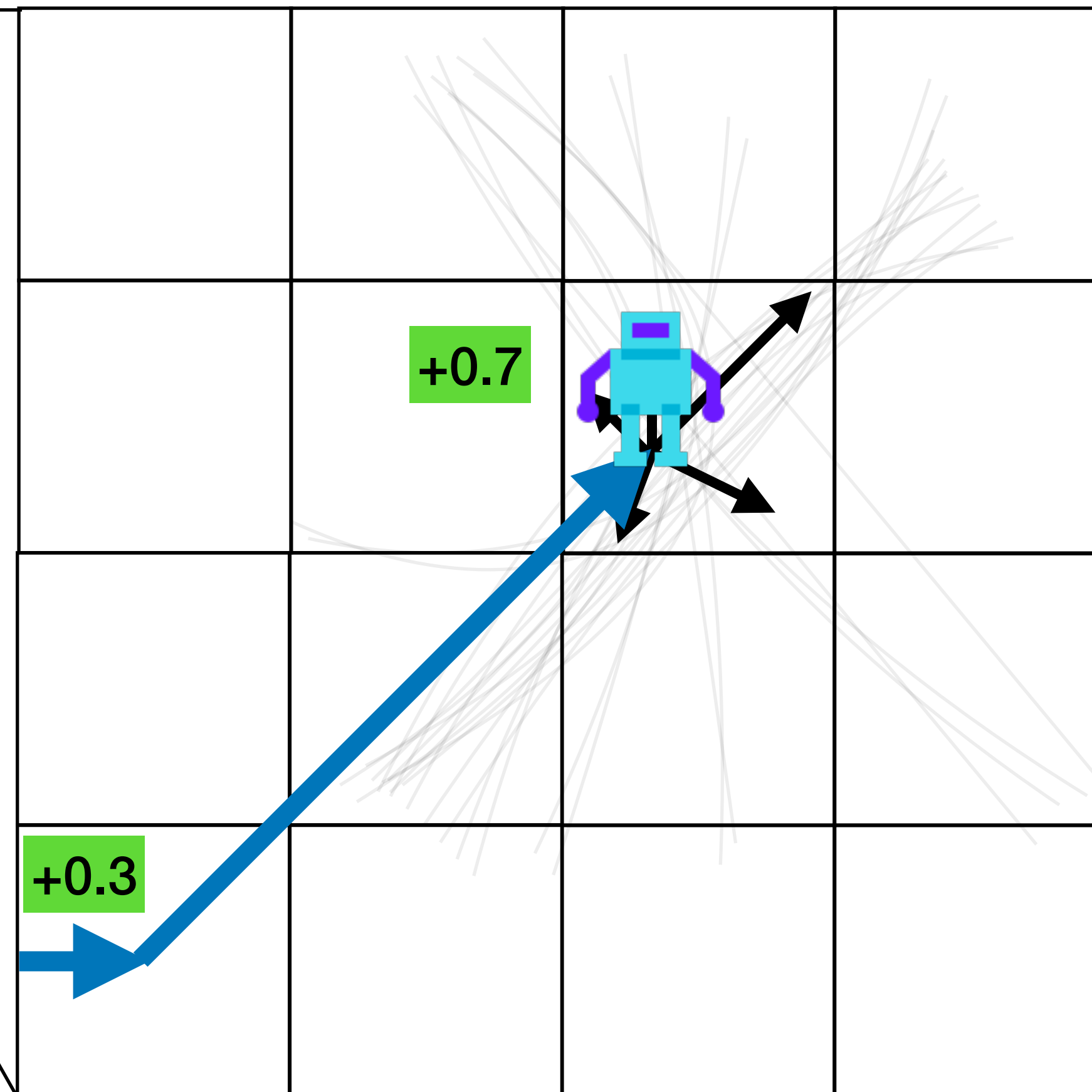
Apprentissage par renforcement  **Meilleures modélisations?**

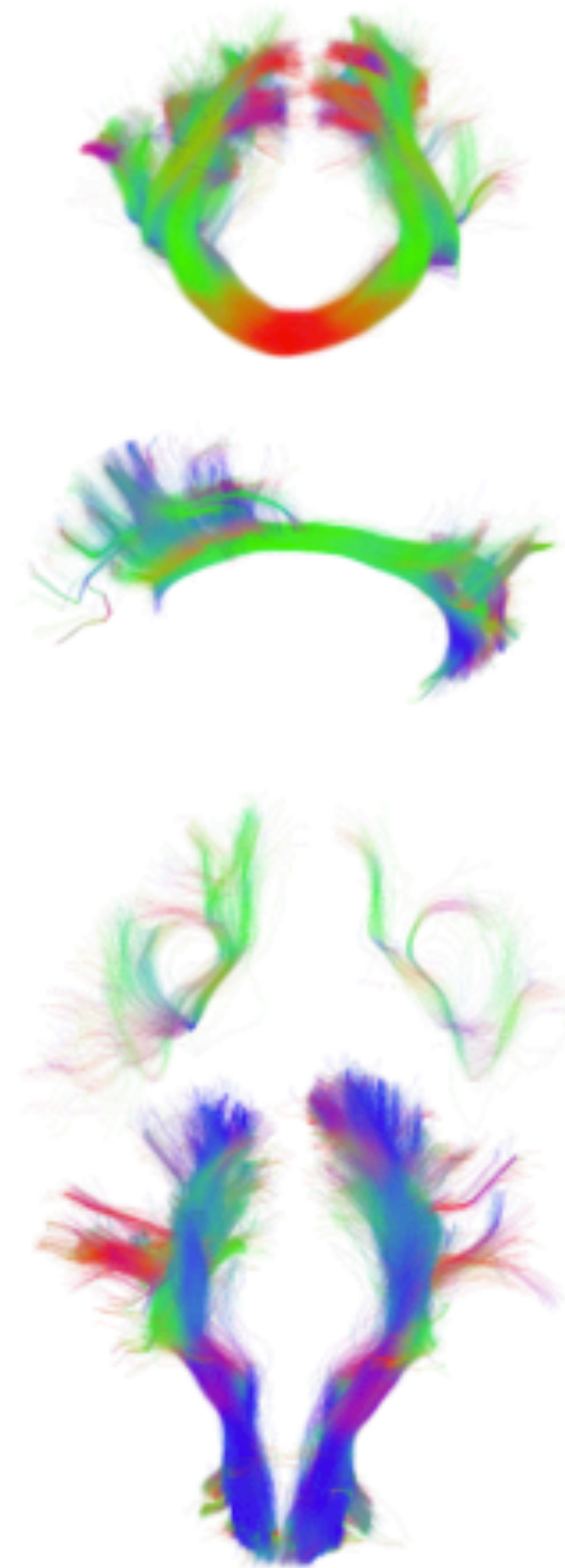
RL + Tractographie



Récompenses:

Entre $[-1, +1]$ selon l'**alignement avec les directions principales**





Référence

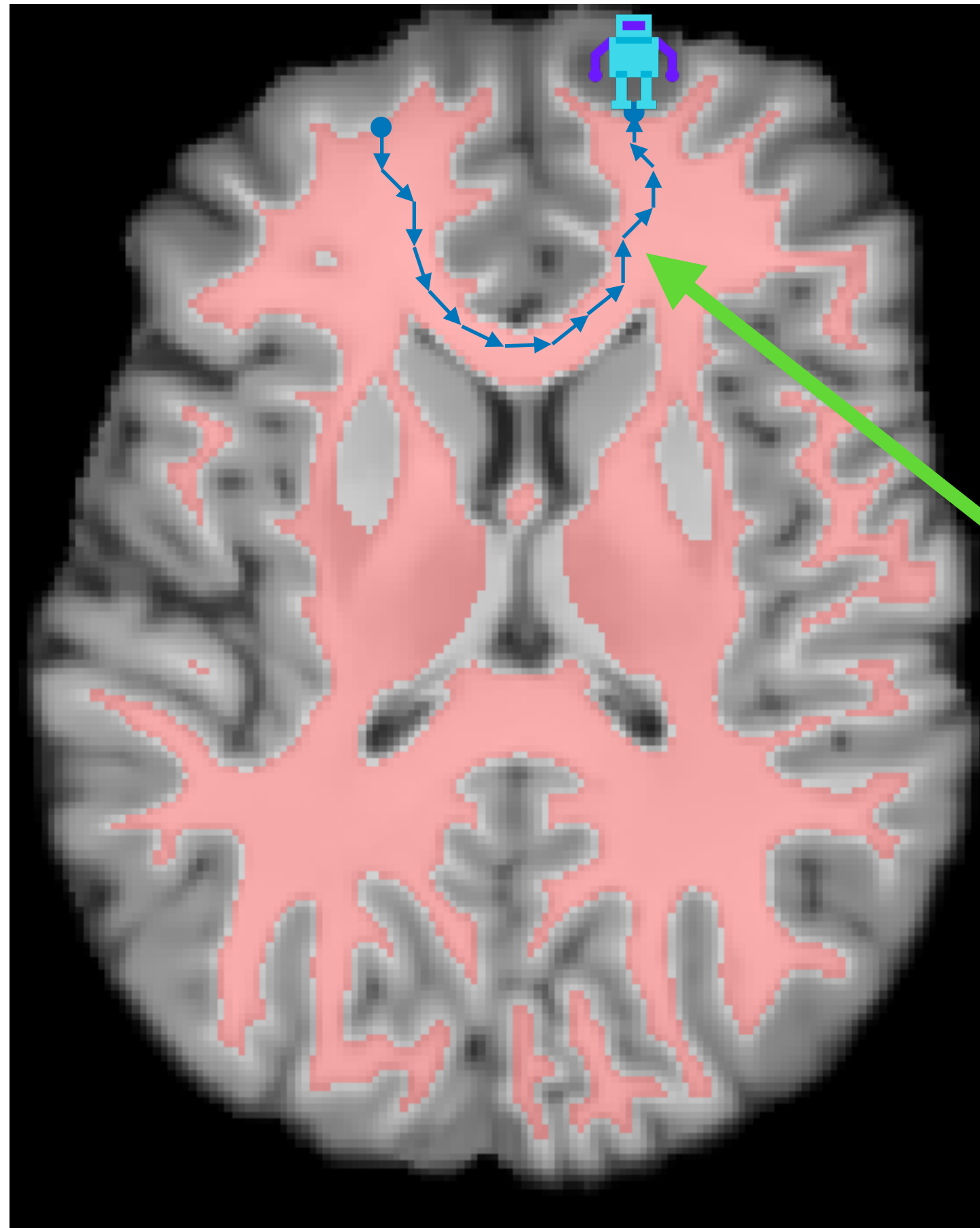


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RL

Récompense alignée avec l'anatomie

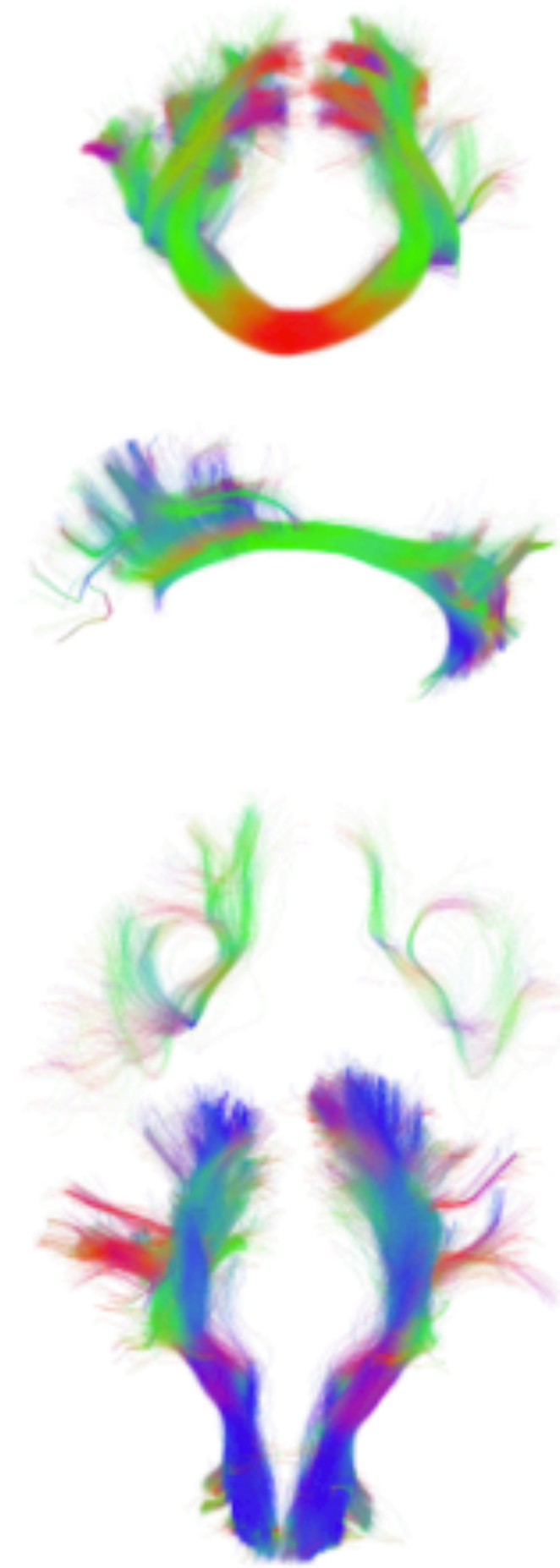


Récompenses:

Entre $[-1, +1]$ selon l'alignement avec les directions principales

Récompense **(+10)** si la reconstruction est valide

C'est une fibre valide: Récompense +10!



Référence



sd_stream



RL



RL+récompense validité

RL + Tractographie = ❤️

Merci