

# Topological Methods for fMRI Data

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**ETH** zürich



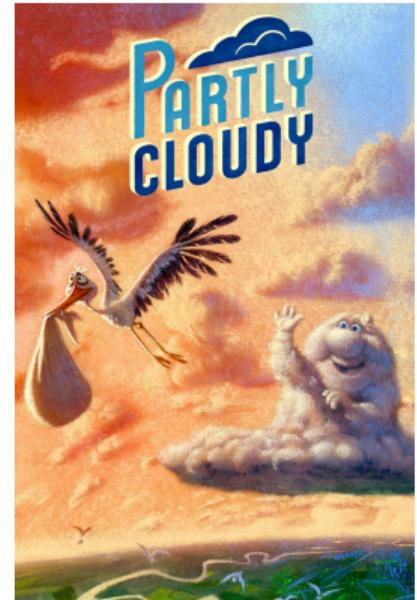
Mila

Université  
de Montréal

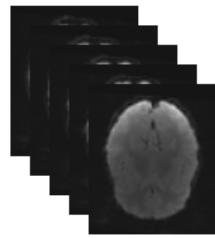
**Yale**

# In a nutshell

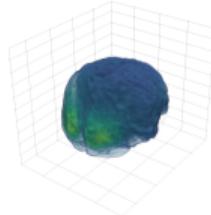
- Get fMRI data (time-varying volumetric data set)
- Analyse time-varying topological features (connected components, cycles, voids)
- Create topological summaries for prediction tasks
- Create topology-based embeddings for analysis tasks



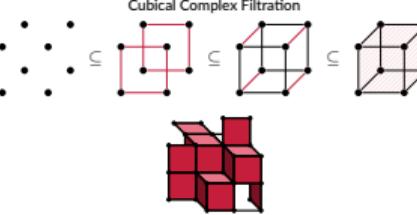
# Our method at a glance



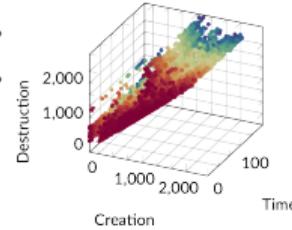
fMRI images



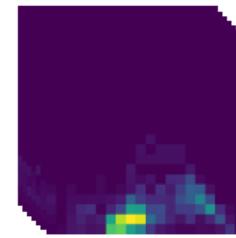
fMRI volume



Cubical complex

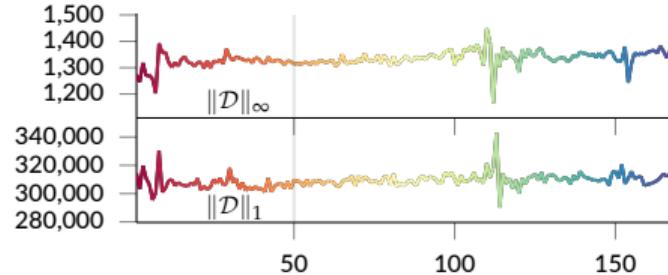
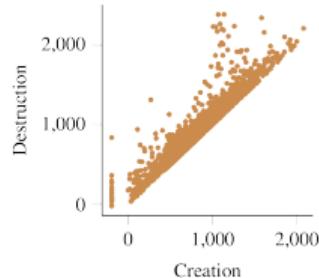
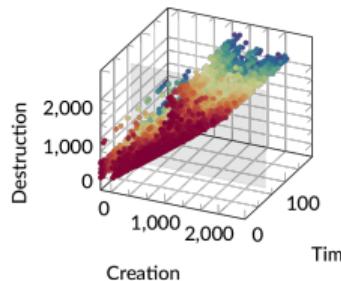


Persistence diagrams



Persistence images

# Topological summaries

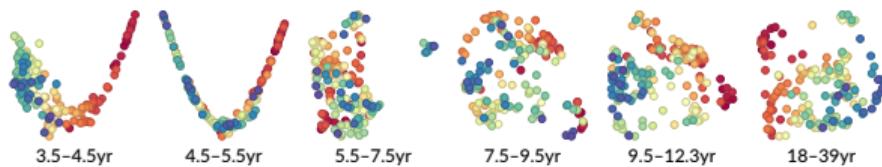


Persistence diagrams Persistence diagram

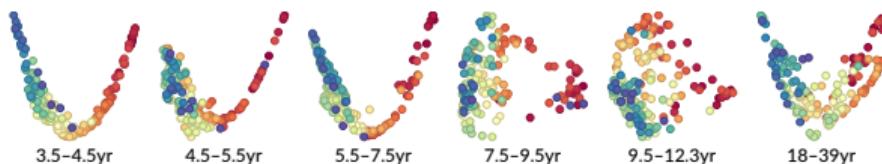
Summary statistics

Method	BM		OM		XM	
	CC	MSE	CC	MSE	CC	MSE
baseline-tt	0.09	10.15	0.02	13.81	0.24	7.19
baseline-pp	0.41	6.23	0.40	6.40	0.40	6.65
srm	0.44	6.05	—	—	—	—
$\ \mathcal{D}\ _1$	0.46	4.27	0.67	2.95	0.48	4.17
$\ \mathcal{D}\ _\infty$	<b>0.61</b>	<b>3.38</b>	<b>0.77</b>	<b>2.20</b>	<b>0.73</b>	<b>2.53</b>

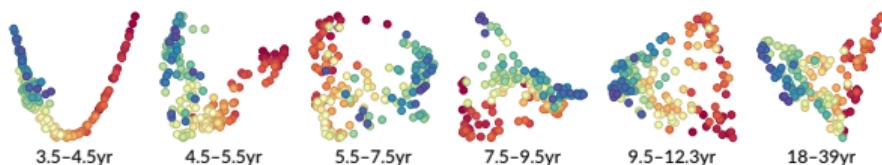
# Brain state trajectories



Whole-brain mask



Occipital-temporal mask



XOR mask

# More!

See our preprint *Uncovering the Topology of Time-Varying fMRI Data using Cubical Persistence* ([arXiv:2006.07882](https://arxiv.org/abs/2006.07882)).

