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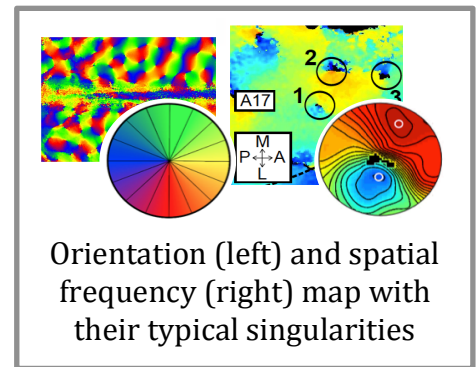
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## Functional organization of vision in the brain: singularities and perception

This project aims at characterizing how the brain organizes to ensure perception. The student will analyze new neuroimaging data recorded in the primary visual cortex. A fascinating property of neurons in charge of processing visual information is that they are tuned to respond to simple attributes such as orientation, spatial frequencies (textures), direction of movement and speed. More intriguingly, it has been shown that the representation of attributes has a very regular geometric organization: each attribute is represented within continuous maps with specific singularities. For instance, orientation maps show typical pinwheel singularities (see Figure).

While it is largely believed that these organizations reflect fundamental principles underlying the development of the maps, and play a role in perception, the actual principles and the processes by which these organization subtend perception are largely unknown.

Using high-resolution imaging, we recently identified new singularities in the spatial frequency map, taking the form of a dipole [1] (see Figure). This led us to the conjecture that singularities may reflect the search for exhaustivity and parsimony in the brain [2].



Orientation (left) and spatial frequency (right) map with their typical singularities

If this hypothesis is true, we shall be able to predict the organization of other attributes. The candidate will be in charge of analyzing the organization of the perception of direction of movement and speed in the visual cortex. The data are already available. The student will:

- Analyze the signals to reconstruct direction and speed maps
- Develop and fit models to characterize the topology of the map
- Develop models to quantify the role of these architectures in perception.

**Requirements:** are a familiarity with Python or Matlab, curiosity and creativity.

**Environment and benefits:** The internship will take place in the Collège de France, and the student will participate to the vibrant scientific life of the Center for Interdisciplinary Research and of the Quartier Latin. The students will receive a remuneration.

### Contact:

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### References:

[1] Ribot, Romagnoni, Milleret, Bennequin, Touboul, NeuroImage 2016

[2] Romagnoni, Ribot, Bennequin, Touboul, Plos Computational Biology 2015