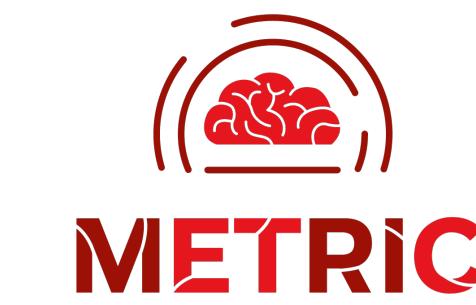


# Denoising of fMRI Volumes using Local Low Rank Methods

P.-A. Comby Z. Amor  
A. Vignaud P. Ciuciu



## CONTEXT

### High Resolution fMRI

#### Signal of interest

Neurovascular coupling gives proxy access to neuronal activity as a *change of  $T_2^*$  contrast* (BOLD) between activity and baseline.

#### Statistical Analysis

Statistical Power limited by *complex Gaussian thermal noise* at Ultra High Field (7 Tesla). *Rician Noise* for magnitude images.

### Local Low Rank Denoising Methods

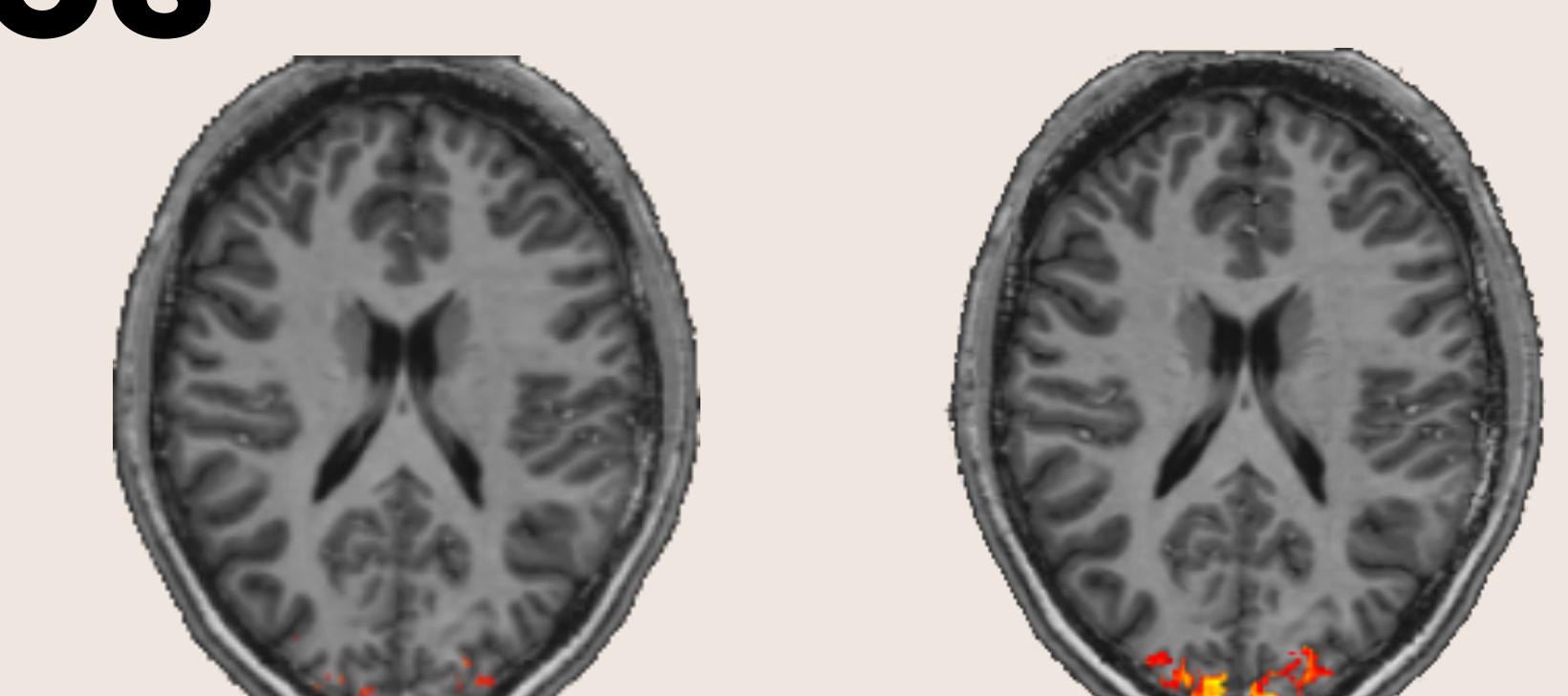
#### Low Rank Hypothesis

Solution provided by *Singular Value Thresholding*

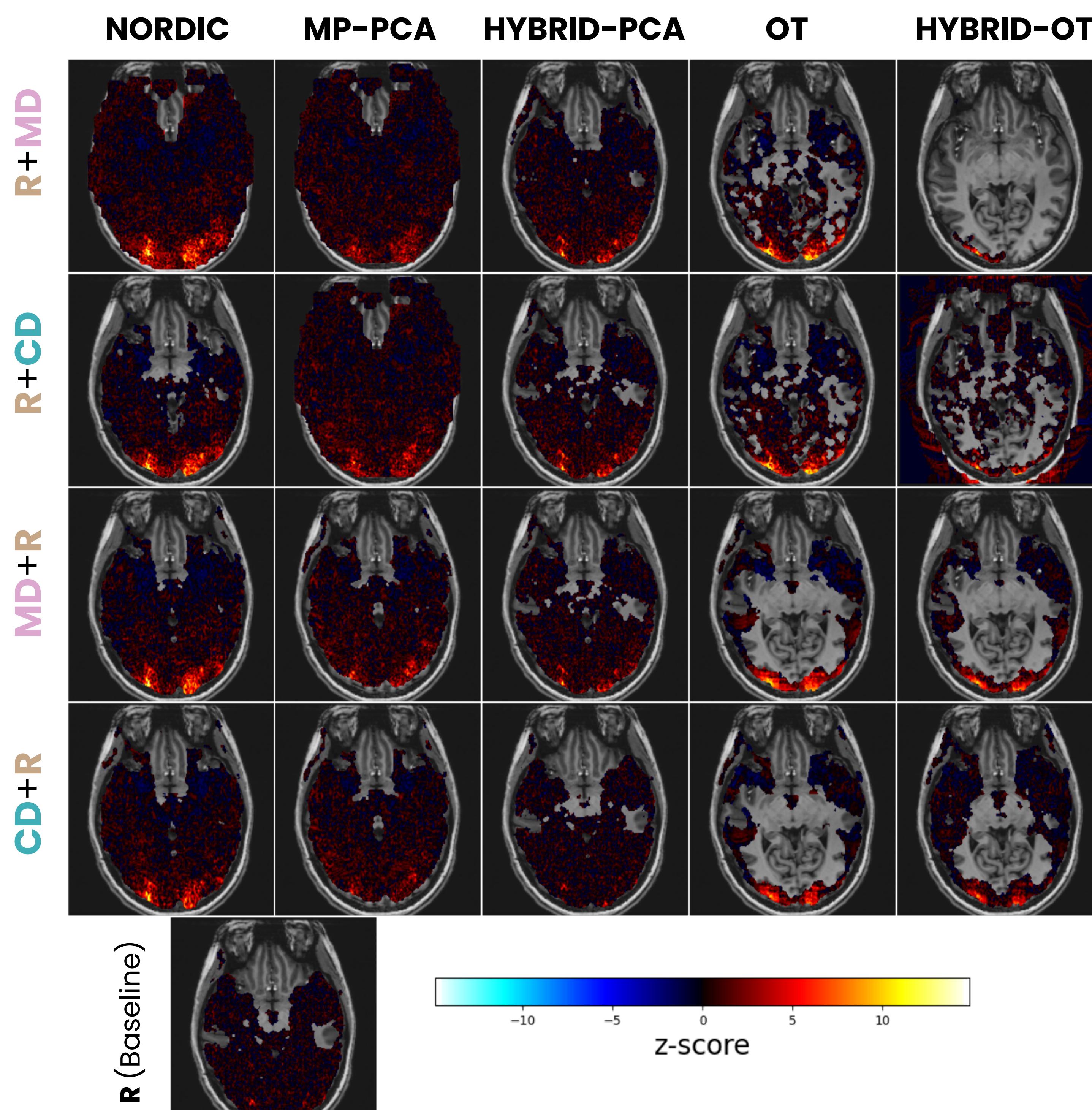
#### Local Formalism

Accommodate the *spatially varying noise structure* using a patch-based processing.

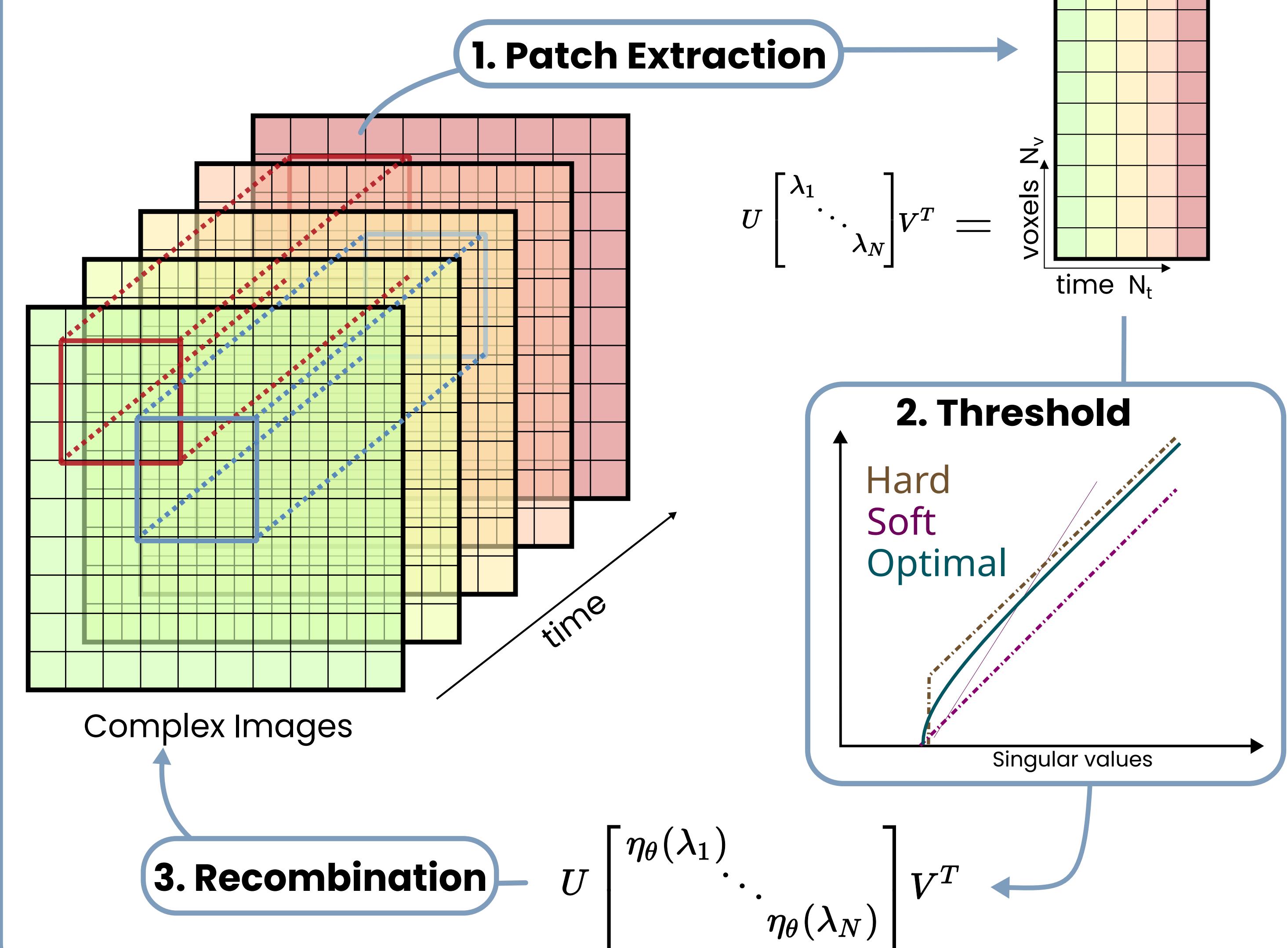
**Local Low rank denoising yields up to x8 more activations in fMRI and also works for magnitude only images**



Denoising OFF      Denoising ON



## LLR GENERAL PROCESSING

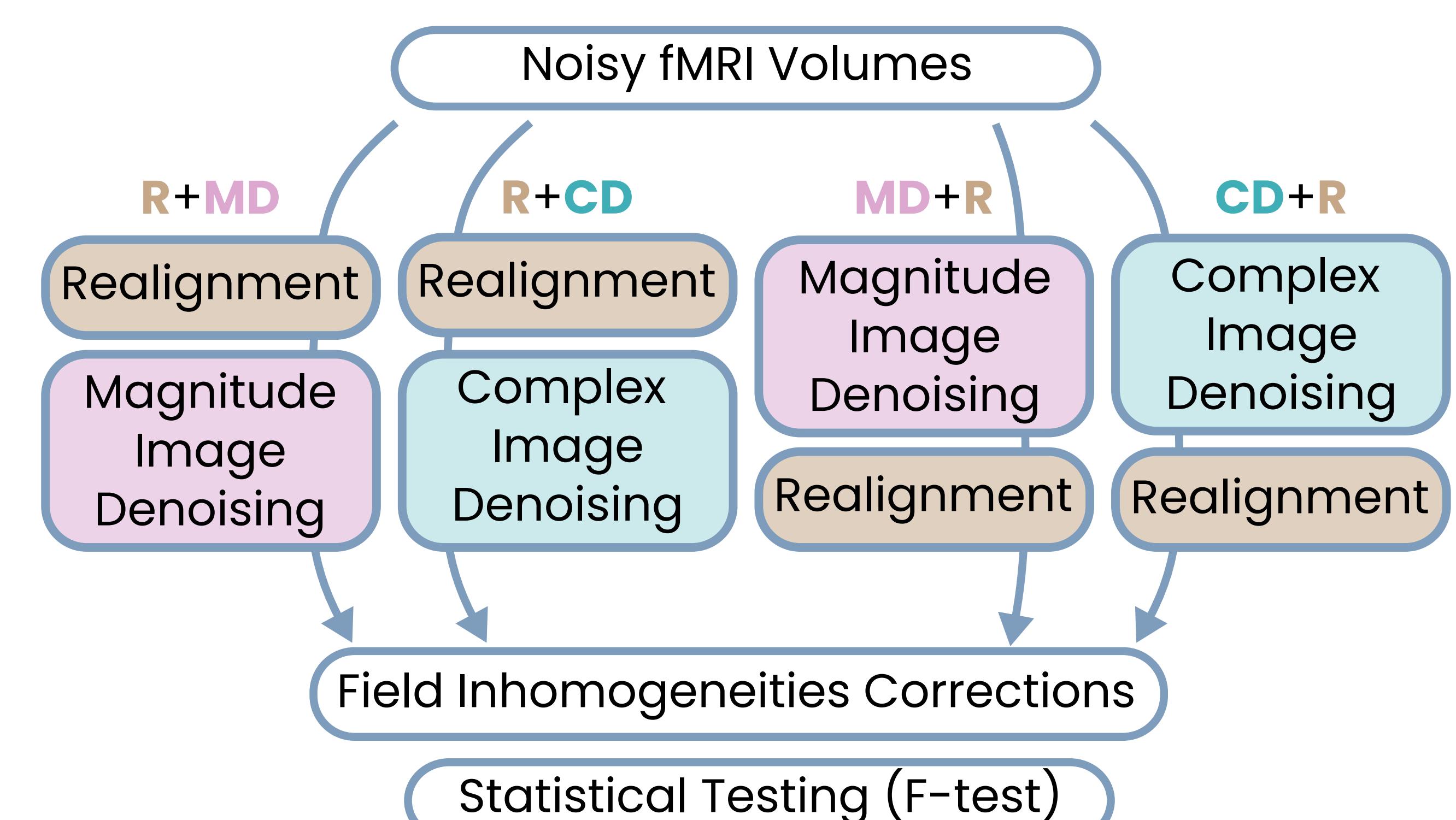


`pip install patch-denoise`

`patch-denoise input.nii output.nii`

## MATERIALS & METHODS

### 4 Scenarios



### Benchmark on 5 methods

Name	Threshold Function	Reference
<b>NORDIC</b>	$\max(0, \lambda - \theta_{global})$	[Vizioli et al. 2021]
<b>MP-PCA</b>	$\max(0, \lambda - \theta_{[u]})$	[Veraart et al. 2016]
<b>HYBRID-PCA</b>	$\max(0, \lambda - \theta_{[u]})$	[Henriques et al. 2022]
<b>OPTIMAL THRESH</b>	$\frac{N_t \sigma^2}{\lambda} \sqrt{\left( \frac{\lambda^2}{N_t \sigma^2} - \beta - 1 \right)^2 - 4\beta} \mathbf{1}_{\frac{\lambda}{\sqrt{N_t \sigma}} \geq 1 + \sqrt{\beta}}$	[Gavish et al. 2017]
<b>HYBRID-OT</b>	$\beta = \frac{N_v}{N_t}$	

### 6 Healthy Volunteers

- 1mm<sup>3</sup> and TR=2.4 s (7 Tesla, EPI3D, full brain FOV)
- Retinotopic mapping paradigm (2 runs of 5 min each)