# Multi-echo fMRI for overt speech production

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SPiN lab

## Overview

# Project phases

1. Methods for *fMRI speech production* (**Methods development**).

2. *Foreign sound learning*, a fMRI experiment (**Methods implementation**).

# Magnetic Resonance Imaging (MRI) –DEVELOPMENT–

How does it work?


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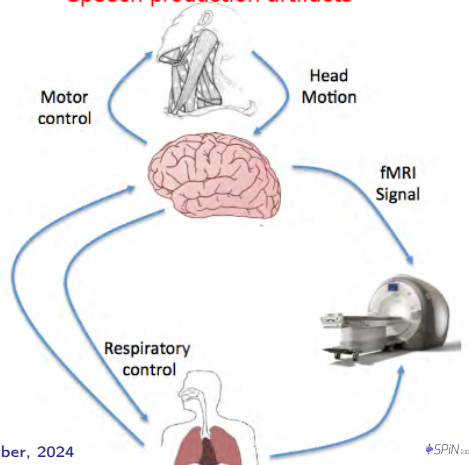
# Magnetic Resonance Imaging (MRI) –DEVELOPMENT–

Measument noise sources!


Speech production artifacts



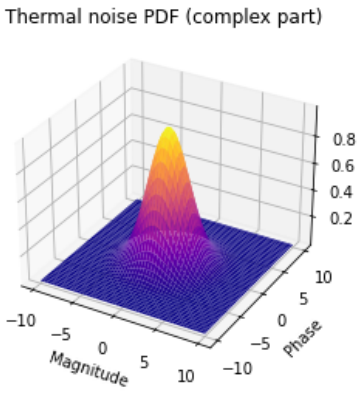
# fMRI parameters *Methods development*

## Problem

What's the best to sample speech production with fMRI?

## Work done

Comparition of computer simulations with different methods



# fMRI parameters *Methods development*

## Problem

How do we clean noise originated in MRI machine?

## Work done

Development and comparison to reduce noise and improve signal measurement.

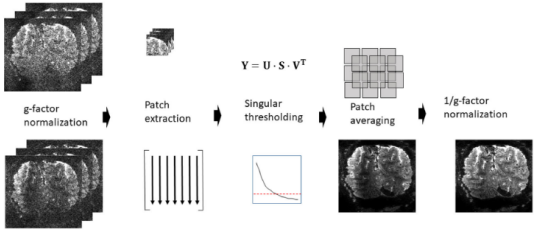
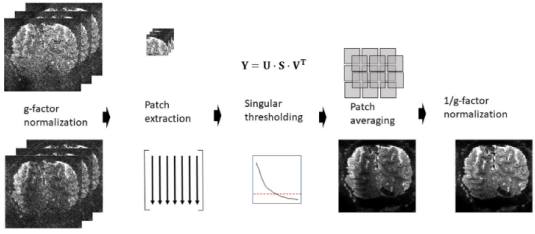



**Fig. 7 Flowchart of the NORDIC algorithm for a series $\boldsymbol{m}(\mathbf{r}, \tau)$.** First, to ensure i.i.d. noise the series is normalized with the calculated $g$-factor kernels as $\boldsymbol{m}(\mathbf{r}, \tau)/g(\mathbf{r})$. From the normalized series, the Casorati matrix $\mathbf{Y} = [\mathbf{y}_1, \cdots, \mathbf{y}_j, \cdots, \mathbf{y}_N]$ is formed, where $\mathbf{y}_j$ is a column vector that contains the voxel values in each patch. The low-rank estimate of $\mathbf{Y}$ is calculated as $\mathbf{Y}_L = \mathbf{U} \cdot \mathbf{S}_{\lambda_{th}} \cdot \mathbf{V}^{\dagger}$, where the singular values in $\mathbf{S}$, $\lambda(i)$ are set to 0 if $\lambda(i) < \lambda_{th}$. After re-forming the series $\boldsymbol{m}^{LR}(\mathbf{r}, \tau)$ with patch averaging, the normalization with the calculated $g$-factor is reversed as $\boldsymbol{m}^{NORDIC}(\mathbf{r}, \tau) = \boldsymbol{m}^{LR}(\mathbf{r}, \tau) \cdot g(\mathbf{r})$.

# fMRI parameters *Methods development*

## Problem

## Work done

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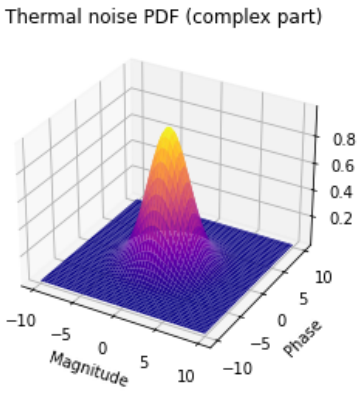
# Speech denoising *Methods development*

## Problem

The more speech, the more artifacts.

## Work done

Speech experiment (e.g., syllables, words, sentences).



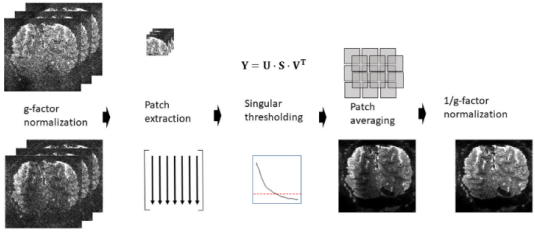
# Speech denoising *Methods development*

## Problem

Need to classify artifacts from signal.

## Work done

Build signal classification algorithm (in course).

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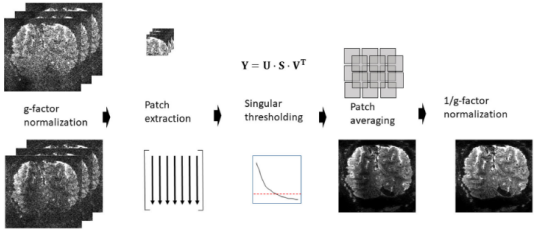
# Speech denoising *Methods development*

## Problem

## Work done

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# Thanks

Thanks!

Eskerrik asko!