On the Stimulation Frequency for SSVEP-Based Image Quality Assessment

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Video Coding & Analytics

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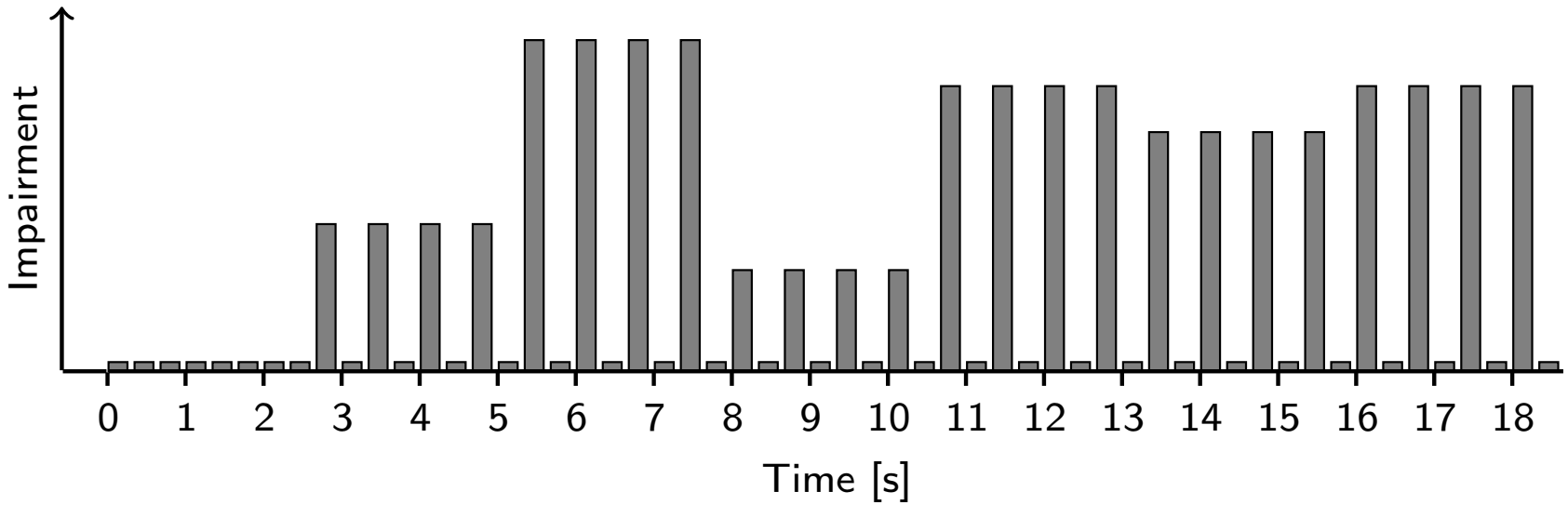
Introduction

Stimulus Presentation for SSVEP-Based Image Quality Assessment



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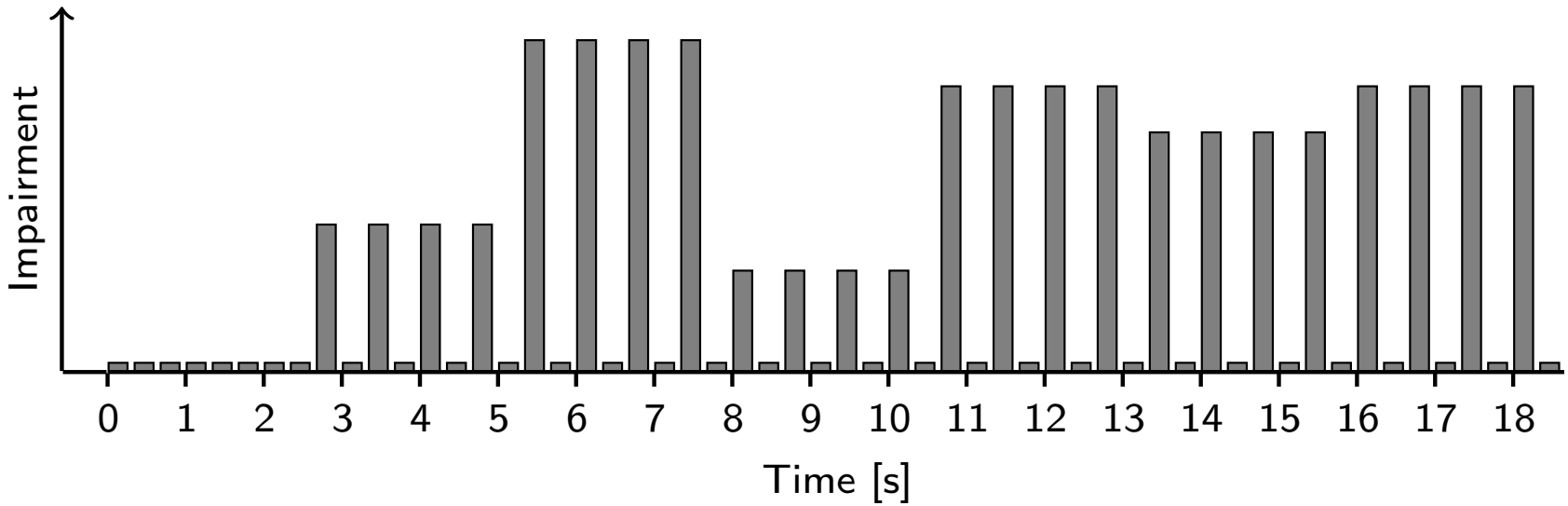
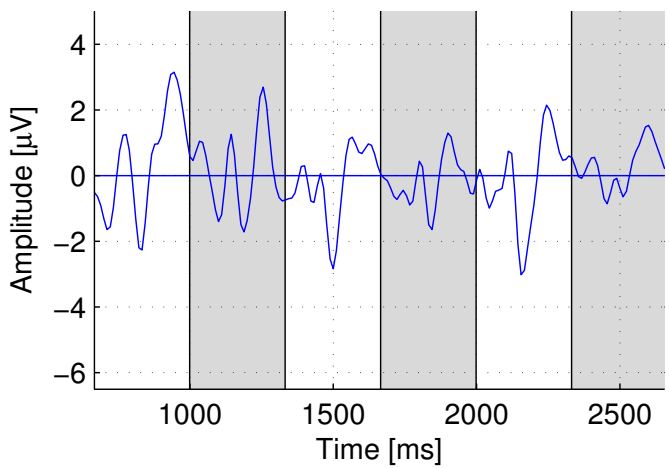
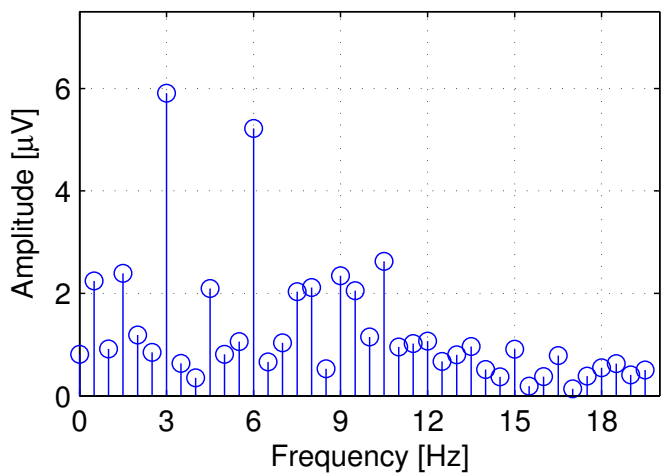


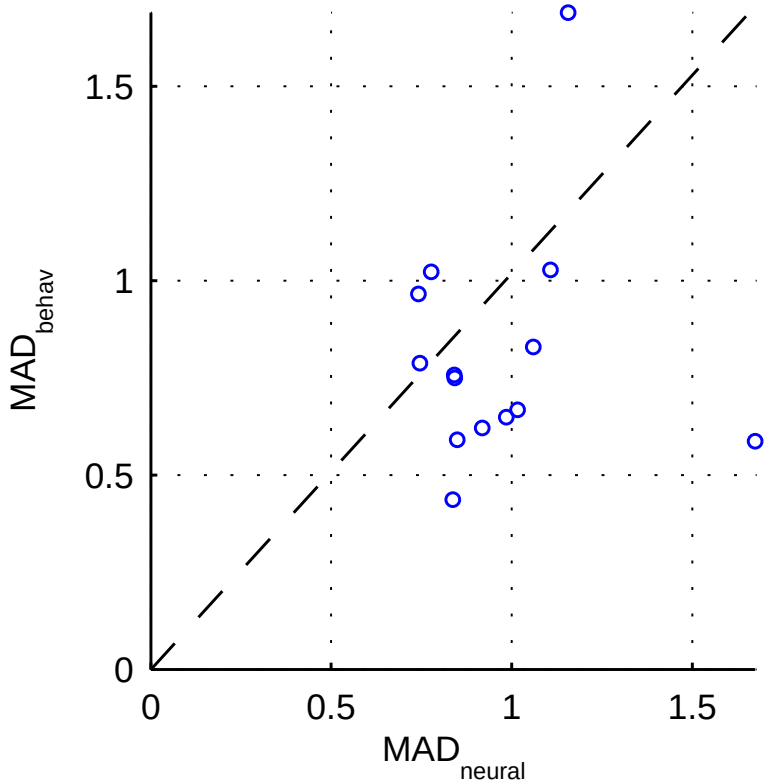




Fraunhofer HHI

Introduction

Predicting MOS from the SSVEP of Individual Participants



⇒ Behavioral and neural accuracy of assessment is statistically equivalent!

Introduction

Questions Left Open (not exhaustive!)

Is there an optimal stimulation frequency?

- An optimal stimulation frequency exists e.g. for face detection
- Previously: $f_{stim} = 1.5Hz$

What quality-related information in encoded different harmonics?

- Odd harmonics: Asymmetric responses
- Even harmonics: Symmetric responses

Experimental Setup

Parameters

- Distortion type
- Source content
- Stimulation frequencies

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  - Restriction to distortion by block-based hybrid compression at 2 impairment levels
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  - Restriction to 6 stimulation frequencies: [2, 3, 5, 6, 7,5, 10] Hz

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  - Restriction to distortion by block-based hybrid compression at 2 impairment levels
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  - Restriction to 6 stimulation frequencies: [2, 3, 5, 6, 7,5, 10] Hz

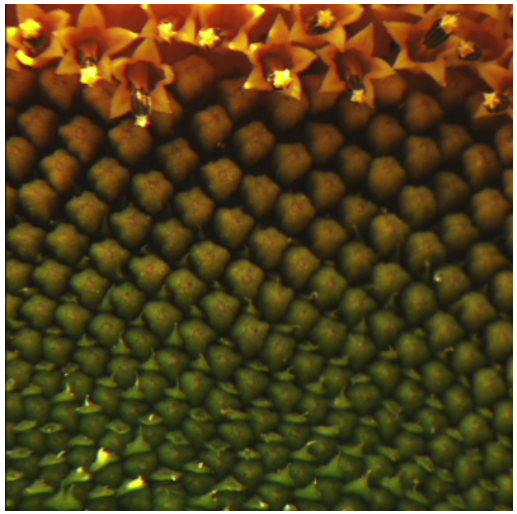
Evaluation based on SNR:

$$\mathrm{SNR} = \frac{P(f_{stim})}{0.5 \cdot (P(f_{stim} - \Delta f) + P(f_{stim} + \Delta_f))}$$

Experimental Setup

Stimulus Material

CrowdRun

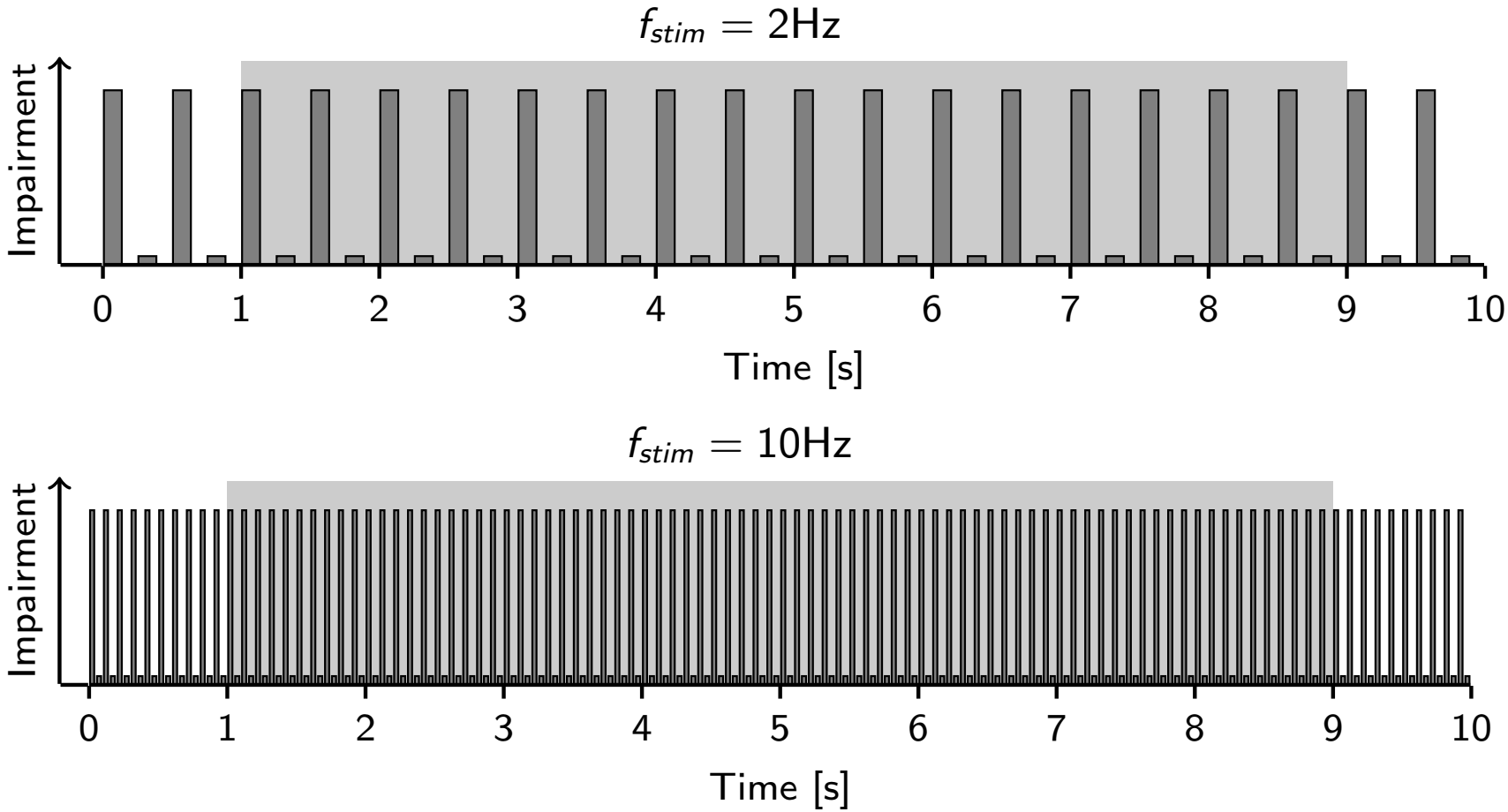


SunFlower

Woods

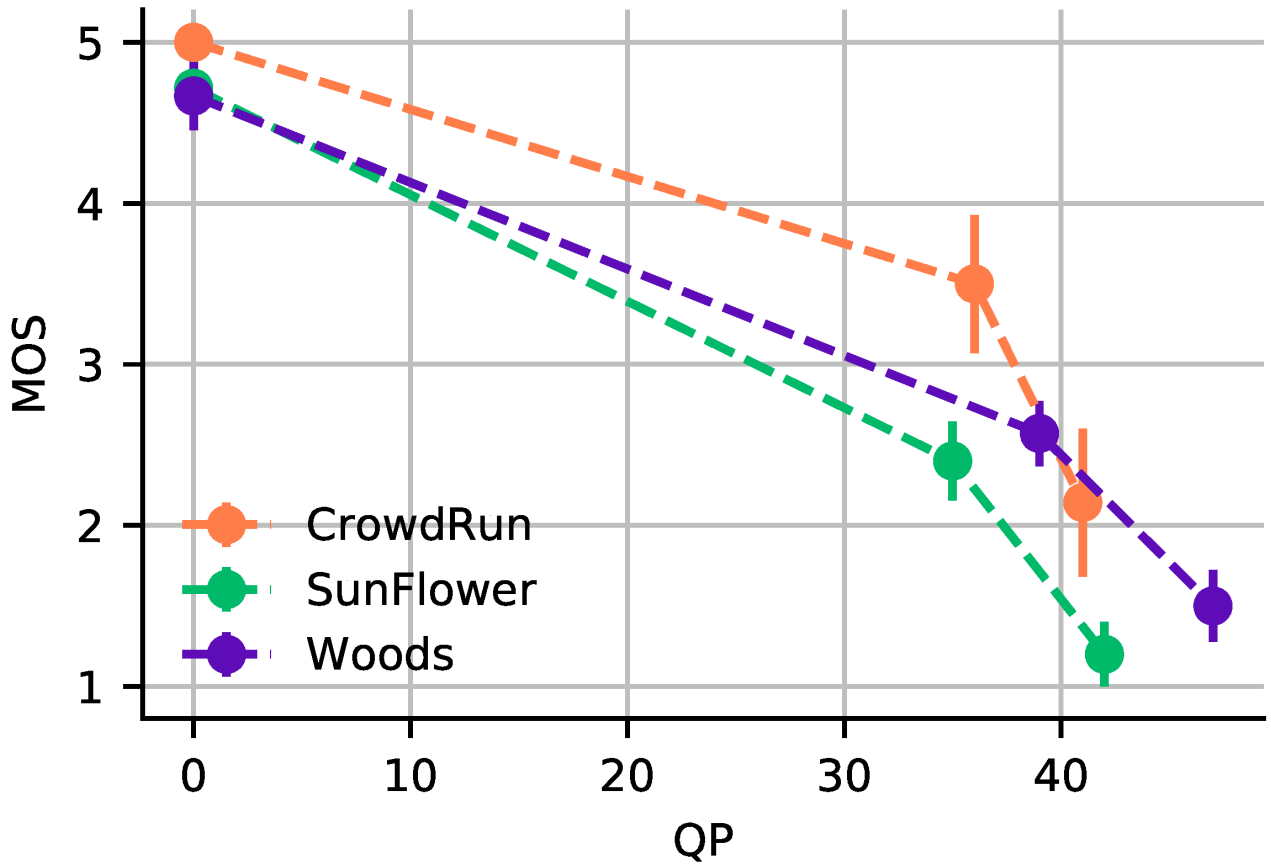
Experimental Setup

Stimulus Presentation



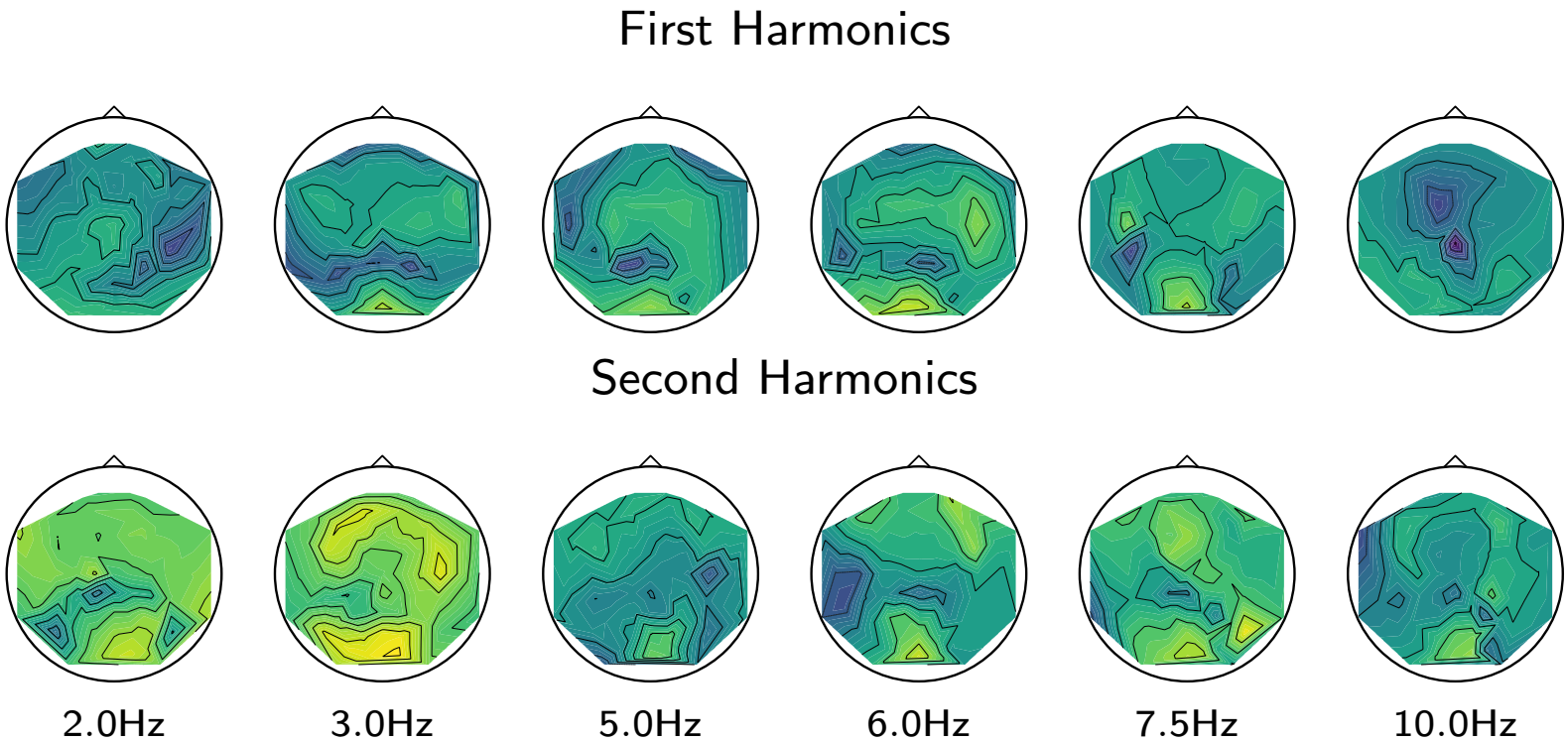
Results

Self-Reported Responses



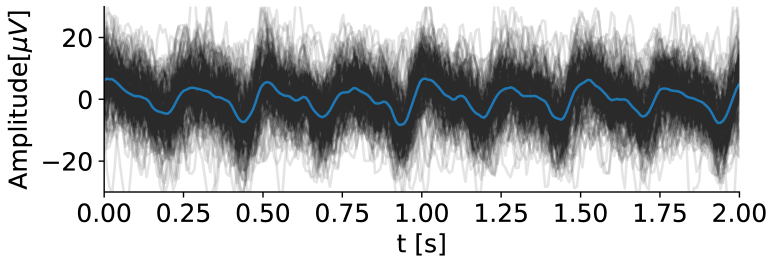
Results

Neural Responses - Scalp Topographies

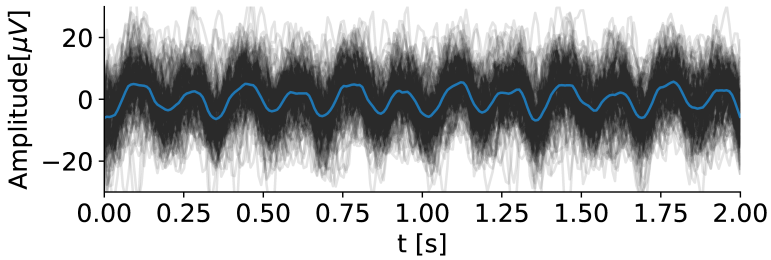


Results

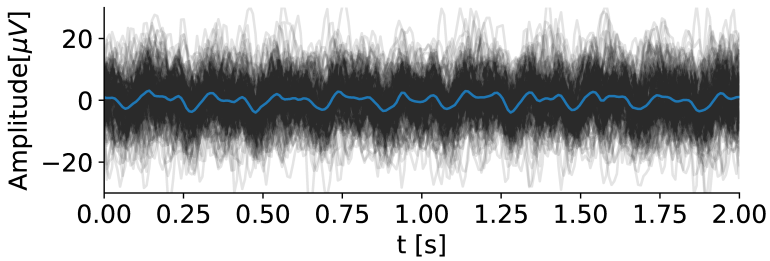
Neural Responses - Signal at Oz



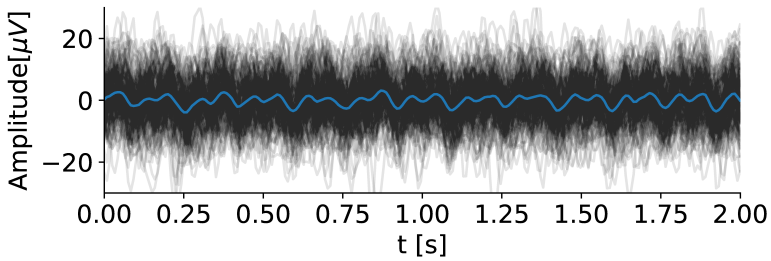
2.0Hz



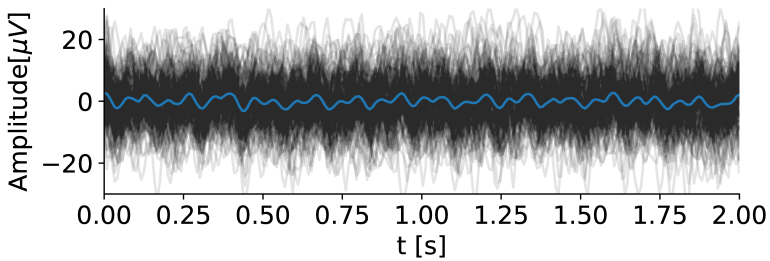
3.0Hz



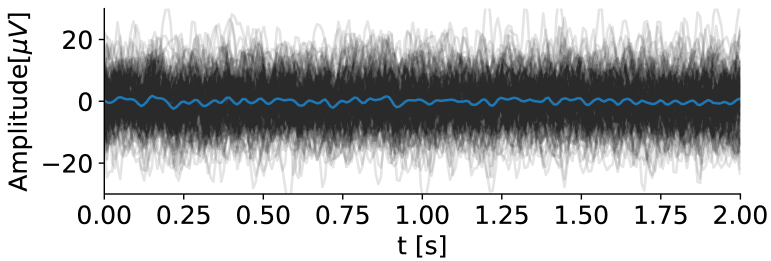
5.0Hz



6.0Hz



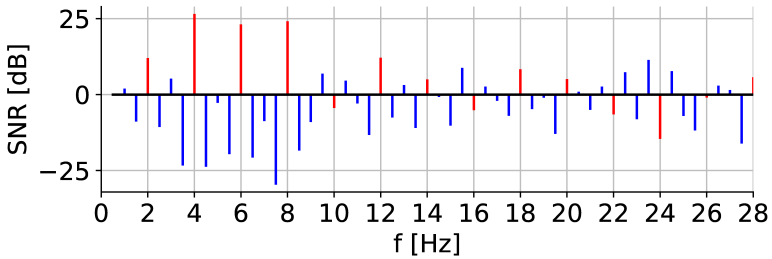
7.5Hz



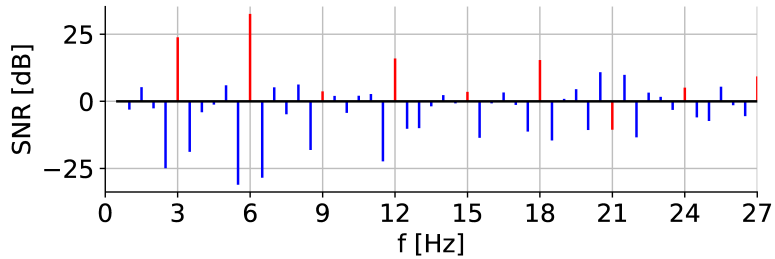
10.0Hz

Results

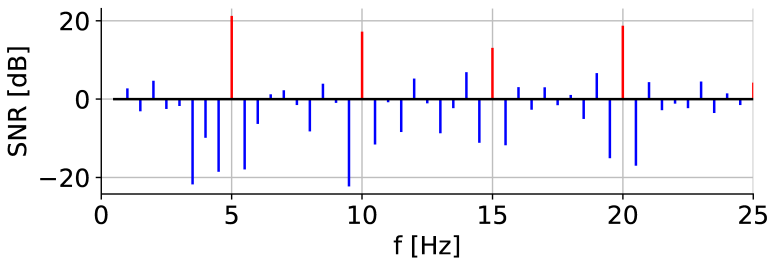
Neural Responses - SNR at Oz



2.0Hz



3.0Hz



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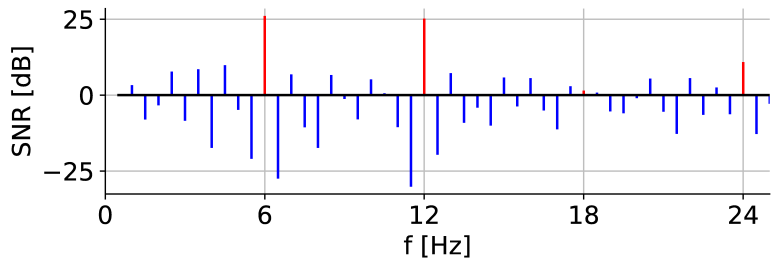
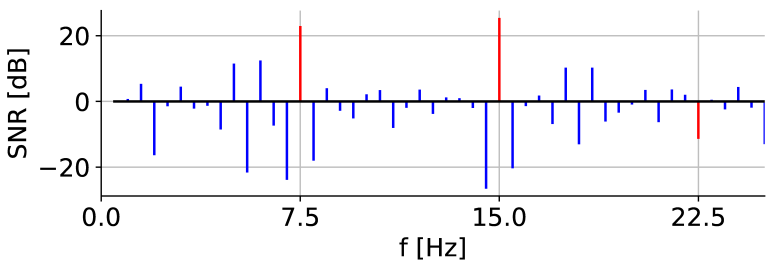


6.0Hz



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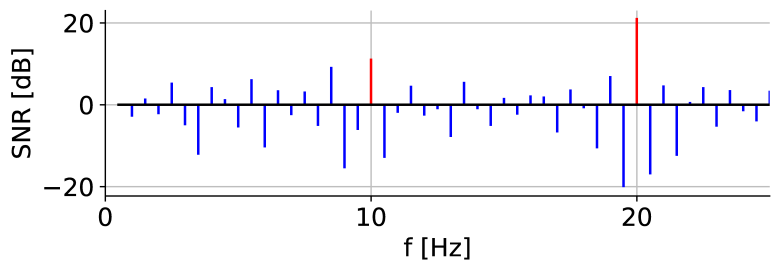
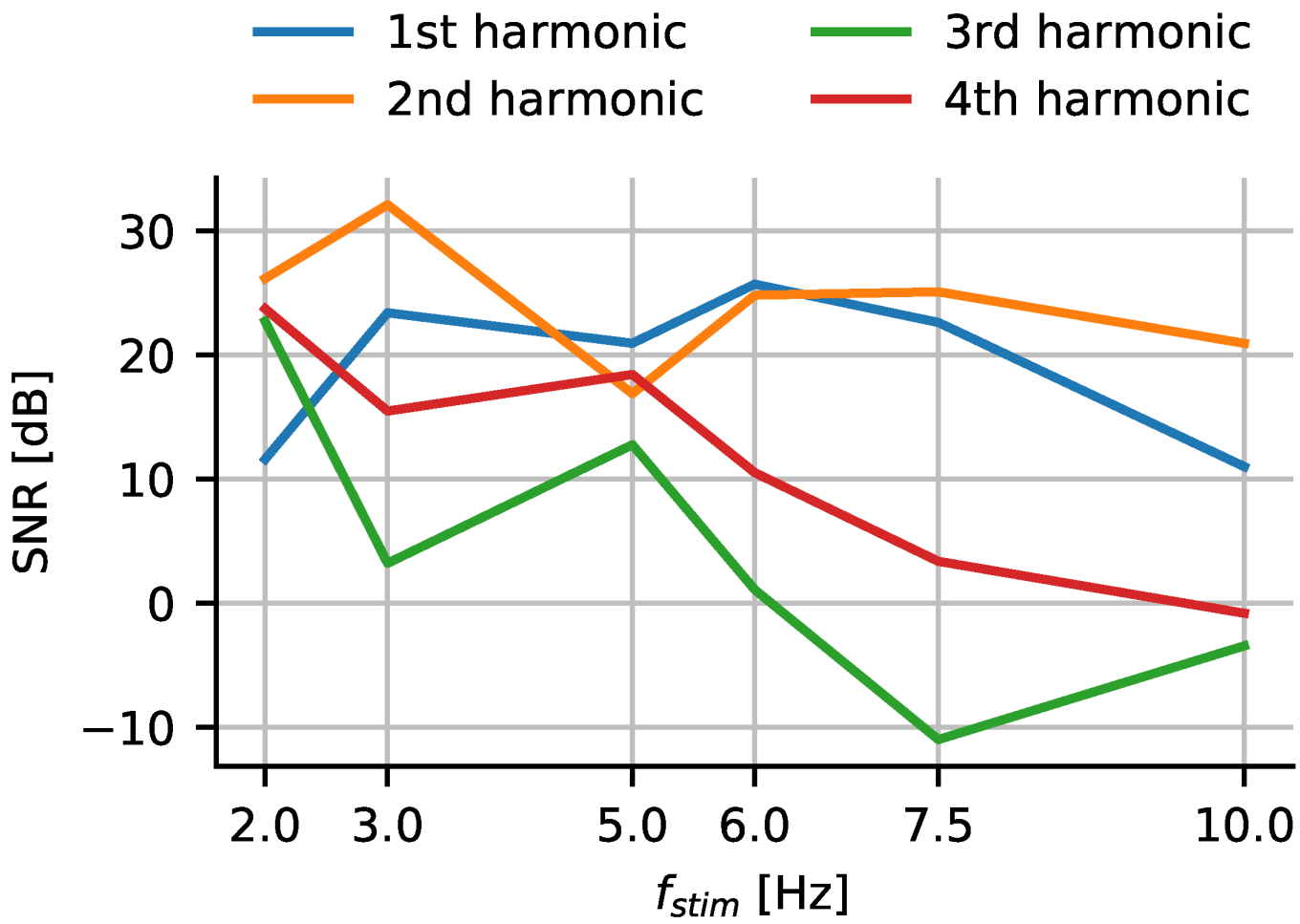


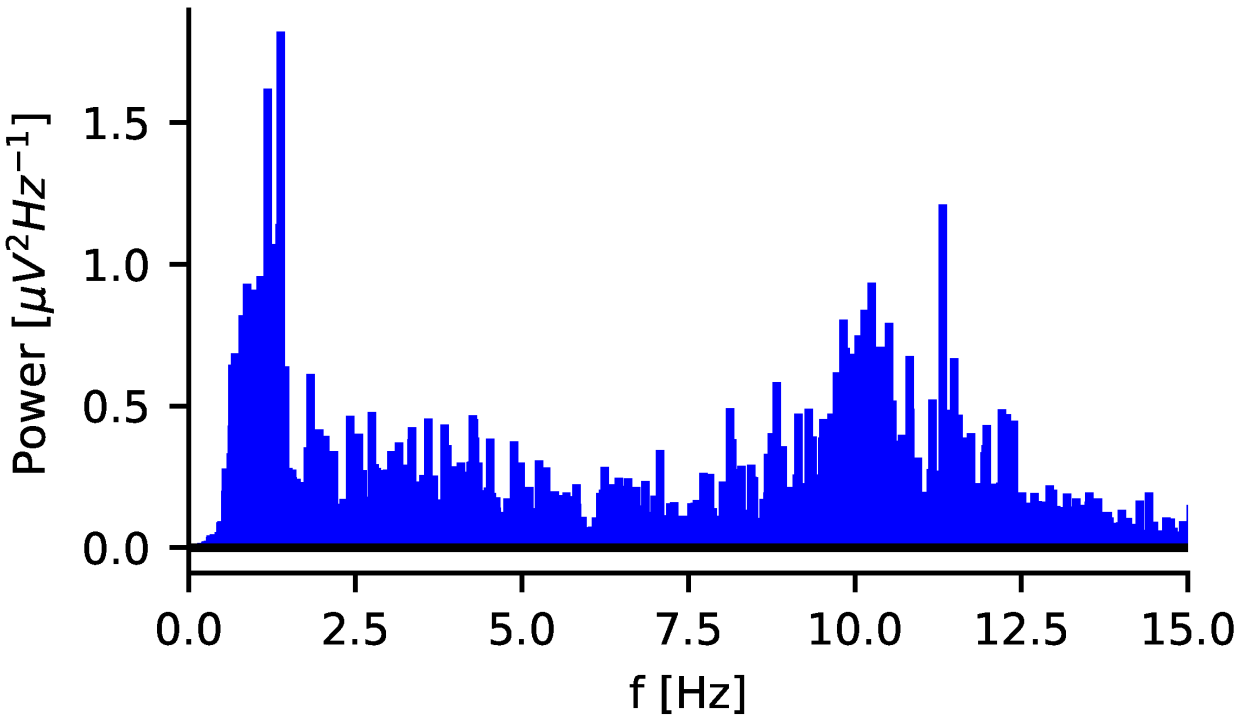
10.0Hz

Results

SNR vs. Stimulation Frequency



Spectrum of Background Activity



Conclusion

- Impact of stimulation frequency on SSVEP-based image quality assessment was studied
- Stimulation frequency has an influence of SNR
- Findings explain high correlations of $4f_{stim}$ with $f_{stim} = 1.5\text{Hz}$
- Influence might be related to the background activity of the EEG

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- Findings explain high correlations of $4f_{stim}$ with $f_{stim} = 1.5\text{Hz}$
- Influence might be related to the background activity of the EEG

- Is the SNR a valid proxy of correlation to MOS?
- Optimal stimulation frequency predicted by subjectwise background activity?
- We still don't know what the different harmonics encode

Thank you!

Any Questions?