Christian-Albrechts-Universität zu Kiel

Questions A

A1. How can the short-time PSD of the background noise be estimated?

- ❑ Which are the two noise estimation schemes presented in the lecture?
- ❑ Propose another scheme to estimate noise!

A2. Frequency-domain solution of the Wiener Filter

- ❑ The frequency-domain solution for orthogonal signals is: …
- ❑ Describe the magnitude frequency response in your own words for the two extrema: only noise; only speech.

A3. Explain the method of minimum tracking for noise estimation.

- ❑ Describe the method in your own words!
- ❑ Which influence do the parameters β, Δ_{inc} and Δ_{dec} have?

A4. What is musical noise?

- ❑ What is musical noise and what is its origin?

Answers B

B1. What are the design criteria of the Wiener Filter?

- Compare slides 29 and 33; optimal separation of wanted and unwanted signals; knowledge of statistical properties up to second order of both signals.

B2. Explain the term formant frequency.

- Formants are the characteristic resonance frequencies of speech sounds created by the vocal tract.

B3. Explain the noise estimation scheme based on voice activity detection.

- In speech pauses, the filter is updated using the parameter β, while speech activity, no adaptation is performed.
- β controls how much the noise estimate fluctuates and how much of the actual spectrum is estimated as noise
- This scheme depends on the robustness of the voice activity detection (VAD) which has higher complexity, but the noise estimate does not rise while speech activity.

B4. What is overestimation?

- The noise estimate is augmented subsequently. Overestimation is applied in order to reduce musical noise.
- Fixed and adaptive overestimation: See slides 43, 44.

Questions B

B1. What are the design criteria of the Wiener Filter?

- ❑ Enumerate the criteria that were presented in the lecture.

B2. Explain the term formant frequency.

- ❑ In the context of speech modeling, what is the meaning of a formant frequency?

B3. Explain the noise estimation scheme based on voice activity detection.

- ❑ Describe the scheme in your own words.
- ❑ Which influence has the parameter β ?
- ❑ What advantages and what drawbacks are there compared to the method of minimum tracking for noise estimation?

B4. What is overestimation?

- ❑ Why is an overestimation factor applied to the noise estimate?
- ❑ Illustrate the presented schemes in your own words.

Answers A

A1. How can the short-time PSD of the background noise be estimated?

- By means of a) tracking of minima, or b) voice activity detection.
- E.g., methods based on multiple microphones, minimum statistics, speech presence probability (SPP)

A2. Frequency-domain solution of the Wiener Filter

- The frequency-domain solution is: $H_{\text{opt}}(e^{j\Omega}) = 1 - \frac{S_{bb}(\Omega)}{S_{yy}(\Omega)}$.
- Only noise: $H_{\text{opt}}(e^{j\Omega}) \to 0$, only speech: $H_{\text{opt}}(e^{j\Omega}) \to 1$.

A3. Explain the method of minimum tracking for noise estimation.

- See lecture slide 41: Smoothing of the PSD; increasing or decreasing the noise estimate in the direction of the smoothed PSD.
- β determines the extent of the smoothing; Δ_{inc} and Δ_{dec} are the step sizes for the adaption.

A4. What is musical noise?

- Musical noise is a fast changing tonal sound which is created by the “opening” and “closing” of the Wiener Filter.