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High Fidelity Algorithmics Group
CS Dept. Stanford University

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CS448J: CASVC 2015 @ Stanford
Exercise Sheet 7: Fourier Transforms

Exercise 1 *(Fourier Transforms, 2 + 2 = 4 Points)*

Determine the Fourier transforms of the Gaussian function

$$g(t) := \frac{1}{\sqrt{2\pi}} \exp(-t^2/2)$$

and the box function

$$b(t) := \begin{cases} 1 & \text{if } t \in [-1/2, 1/2] \\ 0, & \text{else} \end{cases} .$$

Exercise 2 *(Gábor Transform, 2 + 2 + 3 = 7 Points)*

For the Gábor transform with window function

$$g_{\omega_0,t_0}(t) := \pi^{-1/4} \frac{1}{\sqrt{2\pi}} \exp(-2\pi i \omega_0 t) \exp(-\pi(t-t_0)^2)$$

verify, that the center of g_{ω_0,t_0} is given by $t_0(g_{\omega_0,t_0}) = t_0$, the center of $\hat{g}_{\omega_0,t_0}$ is given by $\omega_0(g_{\omega_0,t_0}) = \omega_0$, and that g_{ω_0,t_0} has minimal uncertainty, i.e. $T(g_{\omega_0,t_0}) \cdot \Omega(g_{\omega_0,t_0}) = 1/(4\pi)$.

Exercise 3 *(FFT Big Oh Time Complexity, 6 Points)*

Determine a Big Oh estimation of the time complexity of the FFT.

Notes

- The Homework is due by 10:30am on Nov. 17. Written solutions should be handed in before the lecture. Programming assignments must be submitted by email to your tutor David Hyde <dabh@stanford.edu>.
- In case you have any questions about the assignments, please contact your tutor David Hyde <dabh@stanford.edu> or the instructor Prof. Dominik L. Michels <michels@cs.stanford.edu> directly via email.
- Office hours are every Friday, 10-12 in 208/209 Gates CS Bldg. or by appointment.
- The university expects both faculty and students to respect and follow Stanford's Honor Code; see https://communitystandards.stanford.edu/.