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 (Gabor Transform, 2 + 2 + 3 = 7 Points)

For the Gabor 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 \( g_{\omega_0, t_0} \) 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 \( g_{\omega_0, t_0} \) 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/.