Radio Navigation and Radar

2. Exercise

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1. Problem

Determine the time-bandwidth product of

a) the triangular pulse

$$\underline{s}(t) = \Lambda\left(\frac{t}{T}\right)$$

and

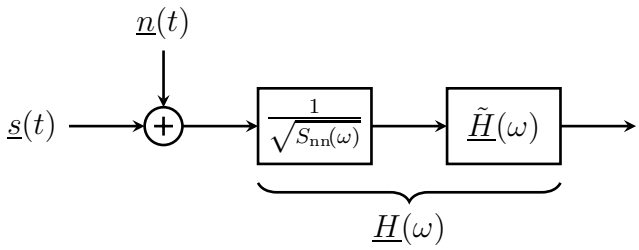
b) the half-wave pulse

$$\underline{s}(t) = \cos\left(\frac{\pi t}{T}\right) \mathrm{rect}\left(\frac{t}{T}\right).$$

2. Problem

In the following a scenario is considered where the received signal results from the superposition of a known waveform $\underline{s}(t)$ and colored noise $\underline{n}(t)$ with the known power density spectrum $S_{\mathrm{nn}}(\omega)$, see figure. On the receiver side first a prewhitening filter with the transfer function $1/\sqrt{S_{\mathrm{nn}}(\omega)}$ is applied.

a) Show that the noise after the prewhitening filter is white. Determine the power density N_0 of this whitened noise.



b) Determine the transfer function $\underline{\tilde{H}}(\omega)$ of the matched filter following the prewhitening filter in such a way that the signal-to-noise ratio at the output is maximized.

c) Determine the overall transfer function $\underline{H}(\omega)$ of the receiver filter, i.e., the transfer function of the matched filter for colored noise, resulting from the concatenation of the prewhitening filter and the matched filter for the whitened noise.