Warsaw University of Technology
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**Numerical methods (ENUME)**

**Assignement B: Approximation of functions**

**semester 2025L**

## Assignement No. 10

Find the mean-square approximation of the periodic signal $\sum_{n\in\mathbb{Z}} x(t-nT)$ where

$$x(t) = \begin{cases} A\, e^{\alpha t} \cdot \mathbf{1}(t), & t \in (0, \frac{T}{2}] \\ 0, & t \in (\frac{T}{2}, T] \end{cases}$$

with the finite sum $x_M(t)$ of $M$ terms of the **trigonometric Fourier series**.

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For fixed values of parameters $A$, $\alpha > 0$ and $T$ and a few values of $M \geq 1$:

1. Calculate numerically the coefficients of the trigonometric Fourier series using two integration methods: ($i$) the rectangle method, ($ii$) a suitable Matlab built-in function. Compare the obtained results in function of the integration step $h$ (a rectangle width).
2. Plot the signal $x(t)$ and $x_M(t)$ using values of Fourier series coefficients calculated in 1($i$) and ($ii$) and describe the observed effects.
3. Calculate the approximation mean-square error (for cases 1($i$) and ($ii$)) and draw its plot in function of $M$. How the integration method influences the approximation error?
4. Prepare carefully the report and do not forget about conclusions from your computer experiment.