



## Course: Data-driven models in engineering applications

### 1<sup>st</sup> Assignment

A) Consider the following stochastic field:

$$E(x) = 10(1 + f(x))$$

where  $f(x)$  is a zero-mean stationary Gaussian field with unit variance and  $x \in [0, 5](m)$ . The autocorrelation function for  $f$  is  $R_f(\tau) = \exp(-|\tau|/2)$ .

1. Use the Karhunen-Loeve series expansion method to generate  $N=5000$  realizations of the field  $E(x)$ .
2. Justify the number of terms you retained in the KL-expansion.
3. Calculate the ensemble average and the ensemble variance from these realizations. To which values would they converge as we increase the number  $N$  of realizations?

B) Consider the zero-mean Gaussian process  $X(t)$ ,  $t \in [0, 10]$  (sec), which has the following one-sided power-spectrum

$$G(\omega) = \begin{cases} \omega - 1, & 1 \leq \omega \leq 2 \\ 3 - \omega, & 2 < \omega \leq 3 \\ 0, & \text{otherwise} \end{cases}$$

1. Use the Spectral Representation method to generate  $N=5000$  time-histories (realizations) of the process  $X(t)$ .
2. Calculate the ensemble average and the ensemble variance from these time-histories. To which values would they converge as we increased the number  $N$  of realizations.
3. Calculate the temporal average and temporal variance from a single realization. What do you observe?