

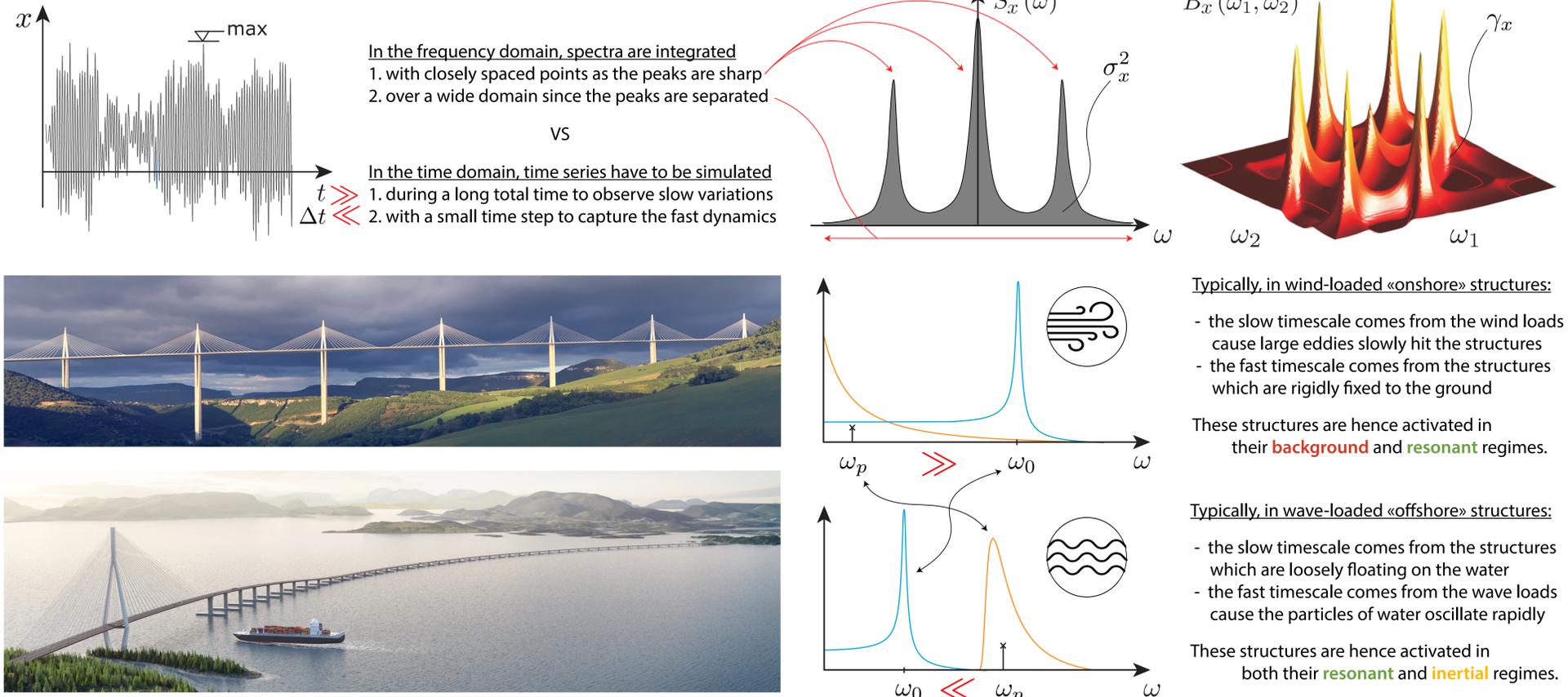
# Do you want to analyze large floating structures much faster ?

## Then use the Multiple Timescale Spectral Analysis !

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### 1. WHY WOULD YOU? WELL, CPU TIME IS PROHIBITIVE FOR THE MOMENT.

When analyzing the responses of large structures to wind and/or wave loadings, a huge number of statistics have to be computed for many configurations, erection stages, environmental conditions,... However, the traditional analysis methods, taking place in the time of in the frequency domain, are actually struggling to provide such values quickly enough because of the **clear separation** that typically exists between the characteristic timescales of the **structure** and of the **loading**.



### 2. HOW DOES THE MULTIPLE TIMESCALE SPECTRAL ANALYSIS WORK?

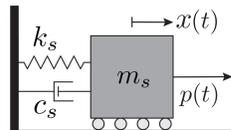
This general framework allows to estimate the statistics with:

- $1+1=2$  → meaningful analytical approximations,
- $\xi \ll 1, (\alpha \ll 1 | \alpha \gg 1)$  → a small and controllable discrepancy,
- → a very large reduction of the CPU time (x 100)

The Multiple Timescale Spectral Analysis method hinges on the perturbation theory to take advantage of the separation of timescales. Indeed, if the peaks of the spectra are separated, their contributions can be considered one after the other by

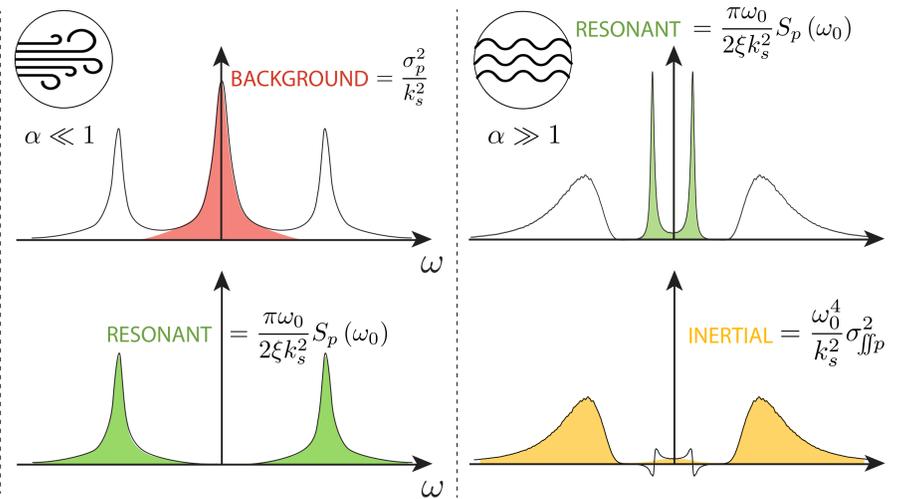
1. locating the position of the main component,
2. focusing on it by using a stretched coordinate,
3. finding a local and integrable approximation,
4. subtracting it to form a new residual function.

Variance of the response of a linear SDOF system:



$$\omega_0 = \sqrt{\frac{k_s}{m_s}}, \alpha = \frac{\omega_p}{\omega_0}$$

$$\xi = \frac{c_s}{2m_s\omega_0} \ll 1$$



### 3. WHAT IS AVAILABLE FOR NOW? AND WHAT IS STILL MISSING?

As shown above, the Multiple Timescale Spectral Analysis has already been used to get the inertial component of the variance of a linear SDOF system. When an oscillator is subjected to a non-Gaussian loading, higher order statistics, such as the skewness, are needed to get a complete probabilistic description of the response. The **bi-inertial** component of the skewness has thus been expressed by using the proposed method as well. An additional part has also been developed for completing the **bi-resonant** component when the bispectrum of the loading is complex-valued.

