# Part III Exercises

## Comprehensive Questions to discuss in the groups

What is the main difference between classical finite and spectral-element methods. What is the meaning of spectral in this context?

The spectral-element method allows in principle arbitrary high-order polynomials inside the elements. Can you give a reason why in practice only low-order polynomials (usually $N \leq 4$) are used, even for large simulations with long propagation distances?

Why can sin and cos functions not be used within the *spectral*-element framework, given that they are so efficient for the pseudo*spectral* method?

Compare finite-difference and spectral-element methods in terms of their potential domains of application in the field of seismic wave propagation. Give arguments.

What are the main advantages of finite-volume methods compared with finite-difference methods?

List the key points that led to the development of the discontinuous Galerkin method in seismology. Discuss the pros and cons of the method compared to finite-element-type methods and the finite-difference method.

What are $p$- and $h$-adaptivity? Why is it straightforward to have this adaptivity with the discontinuous Galerkin method and not with others? Give examples in seismology where this adaptivity can be exploited and why.

## Programming exercises (Choice)

Run “se_homo_1d_solution”, try to understand the code blocks, change “eps” to find the CFL value at which the solution gets unstable. Does “eps” depend on the order of the scheme? Change the dominant period “Tdom” and explore numerical dispersion.

Run “dg_elastic_hetero_1d”, try to understand the code blocks, change “eps” to find the CFL value at which the solution gets unstable. Play with the frequency content of the simulation (change “sig” the halfwidth of the Gaussian initial condition), and play with the order N of the scheme, explore numerical dispersion.