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# Investigating time-scale conditions for the time-parallelization of turbulent flows simulation.

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Direct Numerical Simulation (DNS) of turbulent flows have been widely used by researchers and engineers over the last decades, thanks to High Performance Computing (HPC) and space parallelization techniques. But as the power of HPC resources continues to grow, standard space-parallel algorithms are reaching their limit. Parallelization accross the time domain appears to have the potential of completing space parallelization to reduce time-to-solution for HPC simulation.

Application of time-parallel algorithms to turbulent flow simulation is however very challenging, due to the complex and chaotic nature of the problems and the difficulty of using current time-parallel solutions for highly advective problems. In this talk, we present results from investigating combined space-time parallelization using the Parareal algorithm to simulate canonical turbulent flow problems, namely an Homogeneous Isotropic Turbulence and a Turbulent Channel Flow.

In particular, we show how the time-domain decomposition can have a huge impact on the accuracy and efficiency of the time-parallel algorithm, so taking into account the time-scales of the turbulent flow problem is of high importance. We also present a short theoretical analysis on a simplified problem, that links the time-parallel algorithm efficiency with a physical time scale of the problem. Finally, we give some insights into future challenges that should be solved in order to obtain mature time-parallel methods for turbulent flow simulations.

## REFERENCES

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