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# PARALLEL IN TIME INTEGRATION OF A KINEMATIC DYNAMO

***Andrew T. Clarke[1], Daniel Ruprecht[2], Steven Tobias[3] and Christopher Davies[4]**

[1] University of Leeds, Leeds, LS2 9JT, UK, scatc@leeds.ac.uk,
[2] University of Leeds, Leeds, LS2 9JT, UK, d.ruprecht@leeds.ac.uk,
[3] University of Leeds, Leeds, LS2 9JT, UK, s.m.tobias@leeds.ac.uk,
[4] University of Leeds, Leeds, LS2 9JT, UK, c.davies@leeds.ac.uk ,

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The precise mechanisms responsible for the natural dynamos in the Earth and Sun are still not fully understood. Numerical simulations of natural dynamos are extremely computationally intensive, and are carried out in parameter spaces many orders of magnitude away from real conditions.

Parallelization in space is a common strategy to speed up simulations on high performance computers, but eventually hits a scaling limit. Additional directions of parallelization are desirable to utilise the high number of processor cores now available.

Parallel-in-time methods can deliver speed-up in addition to that offered by spatial partitioning. The Parareal algorithm [1] is the most widely studied parallel-in-time method, and has been utilized for fluids, weather, financial, and other problems.

The talk will investigate Parareal's ability to speed up simulations of the kinematic dynamo, where the velocity field is a prescribed field in the induction equation

$$\frac{\partial \mathbf{B}}{\partial t} = \nabla \times (\mathbf{u} \times \mathbf{B}) + \frac{1}{Rm}\nabla^2 \mathbf{B} \tag{1}$$

We will describe an implementation of Parareal into the open-source Python software Dedalus [2]. Convergence properties, speed-up, and efficiency of the Parareal algorithm for the Roberts flow [3] and other types of dynamos will be presented.

## REFERENCES

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