Excalibur-Neptune report
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Task 1.4 Preconditioning 2D elliptic solvers

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1 Summary

Ben Dudson worked with the winning bidders of call T/NA084/20 (STFC) to assist in exploring different preconditoner approaches for a range of problems including those of relevance to standard cases provided by BOUT++ and SD1D. The output of this work is summarised in reports 2047353-TN-01 through 2047353-TN-04 [1, 2, 3, 4] and the details are not duplicated here. Two key aspects are that it is preferable to explore integration of new preconditioners into libraries such as PETSc rather than directly in BOUT++ and that it is important to test these on realistic problems. In addition to this work we can note that within the existing preconditioners available in BOUT++ it is often beneficial to use preconditioners provided by HYPRE [5] and both BoomerAMG and Euclid options typically offer significant speed up. This is discussed further in the report for 83-2.4.

2 References

[1] S Thorne. Priority equations and Test Cases. `https://github.com/ExCALIBUR-NEPTUNE/Documents/blob/main/reports/2047353/TN-01.pdf`.

[2] V Alexandrov, A Lebedev, E Sahin, S Thorne. Linear systems of equations and preconditioners relating to the NEPTUNE Programme. `https://github.com/ExCALIBUR-NEPTUNE/Documents/blob/main/reports/2047353/TN-02.pdf`.

[3] M Abalenkovs, V Alexandrov, A Lebedve, E Sahin, S Thorne. Implicit factorisation preconditioners for NEPTUNE programme. `https://github.com/ExCALIBUR-NEPTUNE/Documents/blob/main/reports/2047353/TN-03.pdf`.

[4] M Abalenkovs, V Alexandrov, A Lebedve, E Sahin, S Thorne. Implicit factorisation preconditioners for non-symmetric problems. `https://github.com/ExCALIBUR-NEPTUNE/Documents/blob/main/reports/2047353/TN-04.pdf`.

[5] E Chow, A Cleary, and R Falgout. Design of the hypre preconditioner library. 9 1998.