

OpenFOAM High Performance Challenge 1 Software Track

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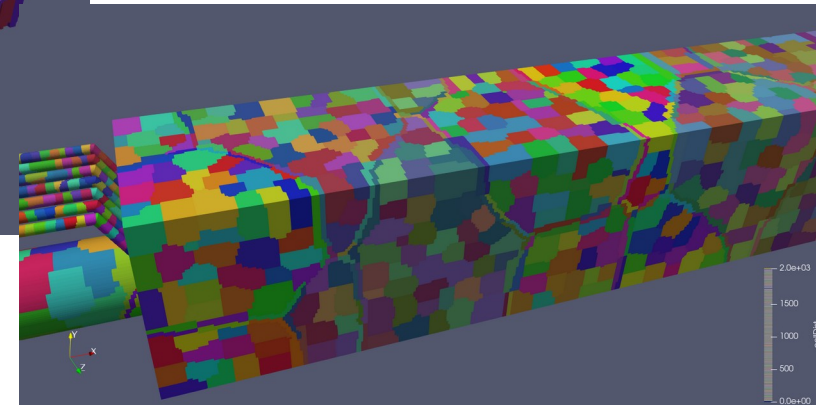
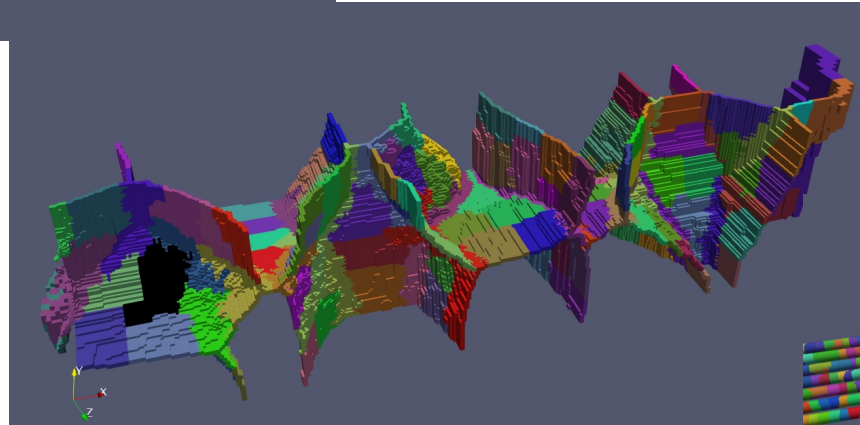
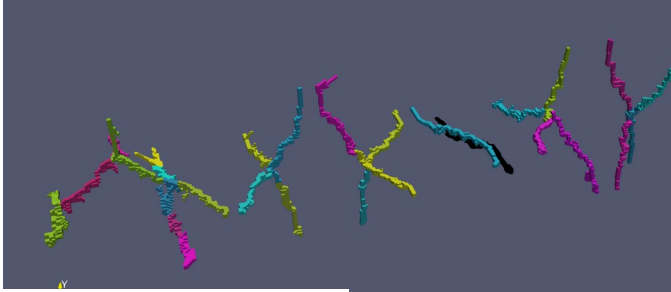
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- Optimised settings (system/fvSchemes, system/fvSolution)
 - Standard analysis typically carried out under a support contract
- Detailed analysis (improved built-in profiling, Score-P) revealed severe delays for partitions with many inter-node boundaries
- Custom mesh partitioner
 - Completely written from scratch
 - Further details on the next slides
 - Yielded about 75% of the performance gains

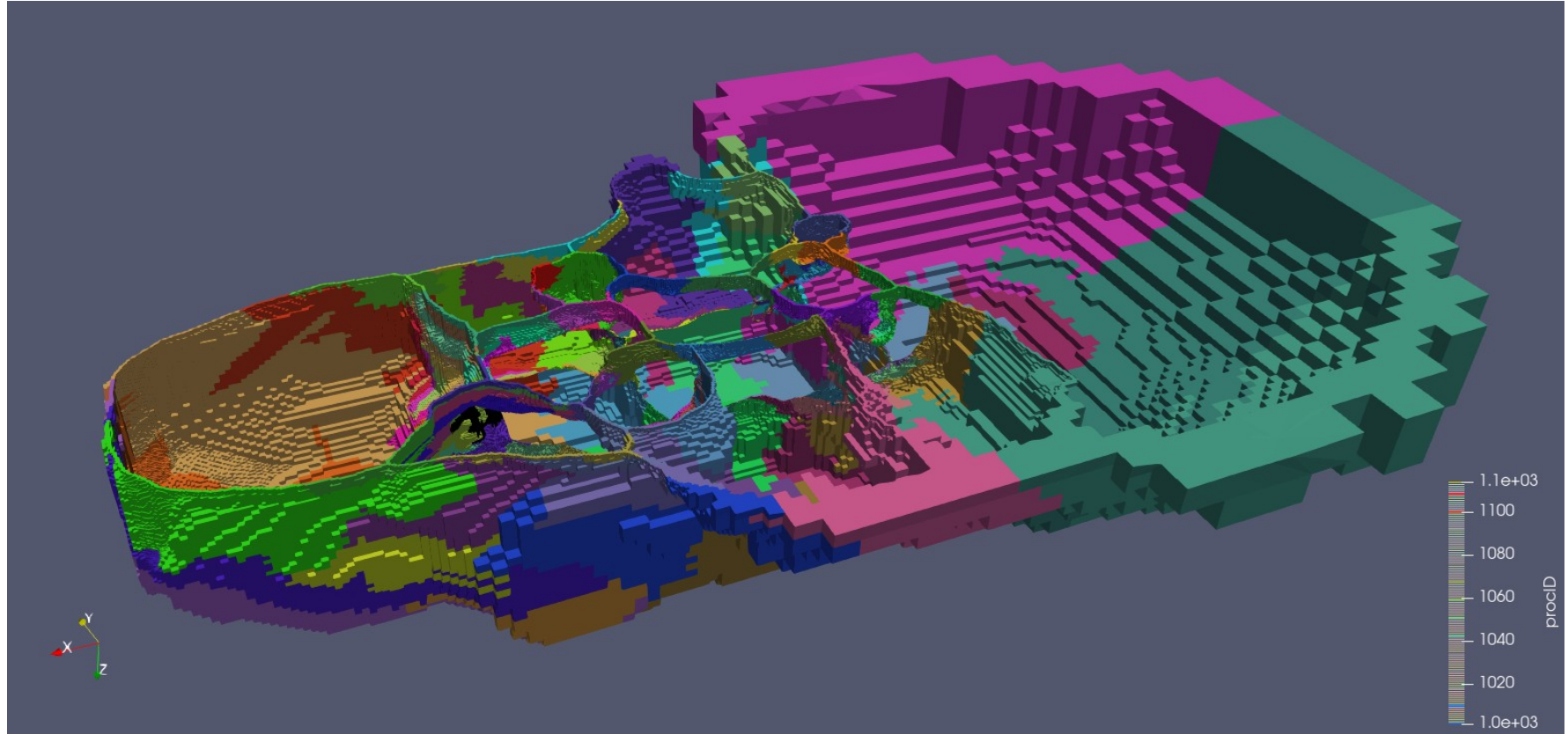
- Inter-node communication is 10x slower than intra-node communication
- Inter-node latency is huge (about 1ms).
- OpenFOAM hides pair-wise communication costs in its linear solvers, but not in matrix assembly
- Traditional partitioning techniques:
 - optimise total communication volume
 - have no notion of inter-node communication and fiddling with the edge weights is not sufficient
 - do not take into account the number of messages (latency)
 - Multistage approaches yield sub-optimal results because inner and outer meshes do not match

- Decompose into nNodes meshes using Scotch
- Analyse the inter-node interfaces
- Produce partitions near the inter-node interfaces such that
 - the number of inter-node messages per partition is optimal
 - the total number of inter-node messages is minimised
 - the messages are not too big.
Note: The message size itself is fine, but load balance becomes an issue
 - the number of intra-node connections is not excessive
- Fill the rest

Novel partitioning - Eye candy



Novel partitioning - Eye candy



Novel mesh partitioner + Tuned settings

Speedup w.r.t. to baseline

N partitions	Mesh size	
	65M	236M
1024	x1.53	x1.45
2048	x1.45	x1.49
4096	x1.73	x1.86
8192	x2.01	x1.72