



Faster Simulations through Dynamic Solver Selection

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PRECONNET

Accelerate Your Simulations

Fully Automatic Linear Solver Optimization

- ✓ Data-driven Preconditioning
- ✓ Data-driven Initial Guess Generation
- ✓ Solver Parameter Tuning
- ✓ Dynamic Solver Selection

i 3.7x speed-up for
pressure-equation in
OpenFOAM CPU-cabinet
simulation

PRECONNET

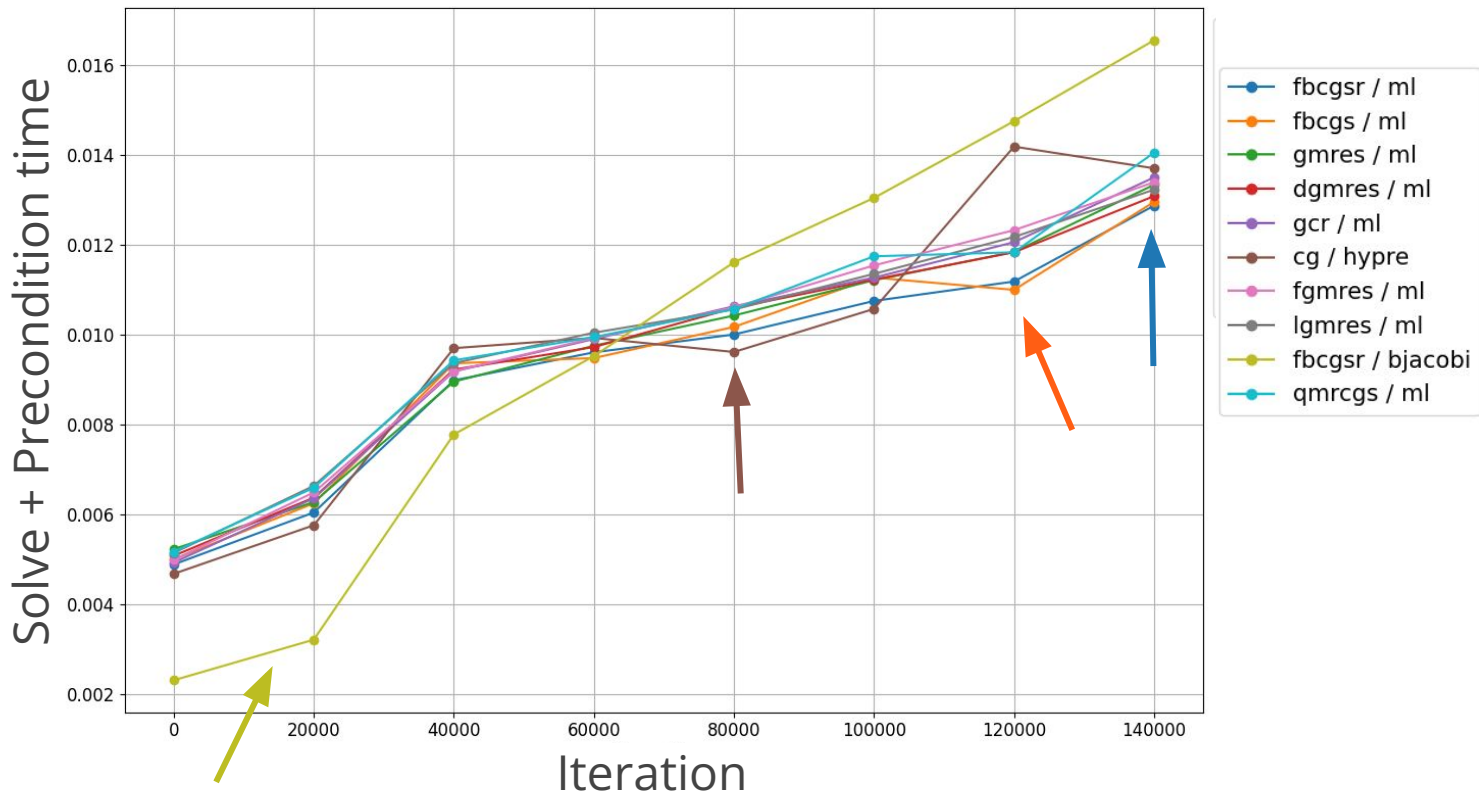
Accelerate Your Simulations

Fully Automatic Linear Solver Optimization

- ✓ Data-driven Preconditioning
- ✓ Data-driven Initial Guess Generation
- ✓ Solver Parameter Tuning
- ✓ **Dynamic Solver Selection**
 - Can dynamic solver selection improve performance? And by how much?
 - How to find the optimal dynamic solver path?
 - Does dynamic solver selection change the quality of the results?

PRECONNET

Accelerate Your Simulations



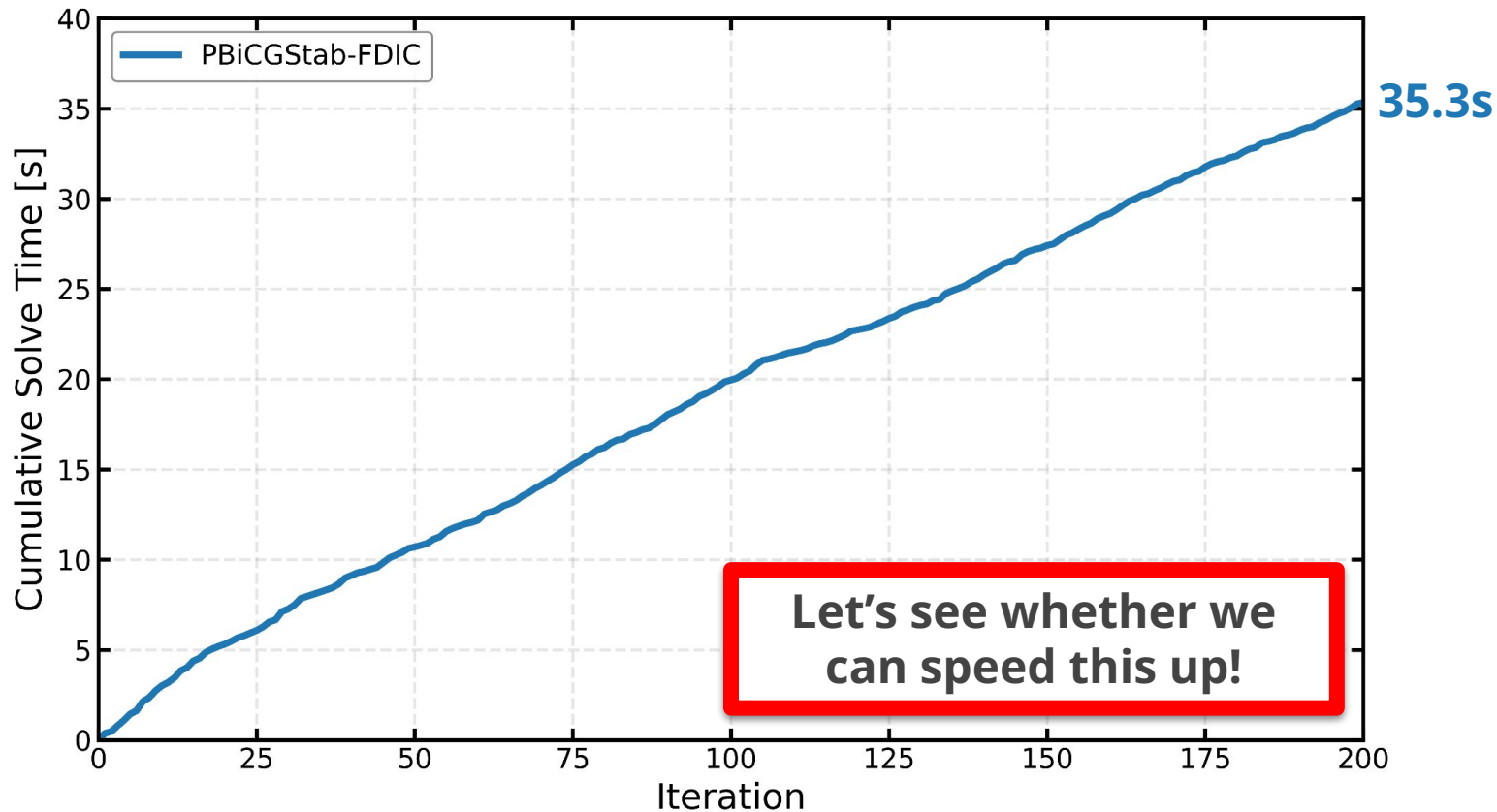
CPU CABINET

OpenFOAM
chtMultiRegionSimpleFoam

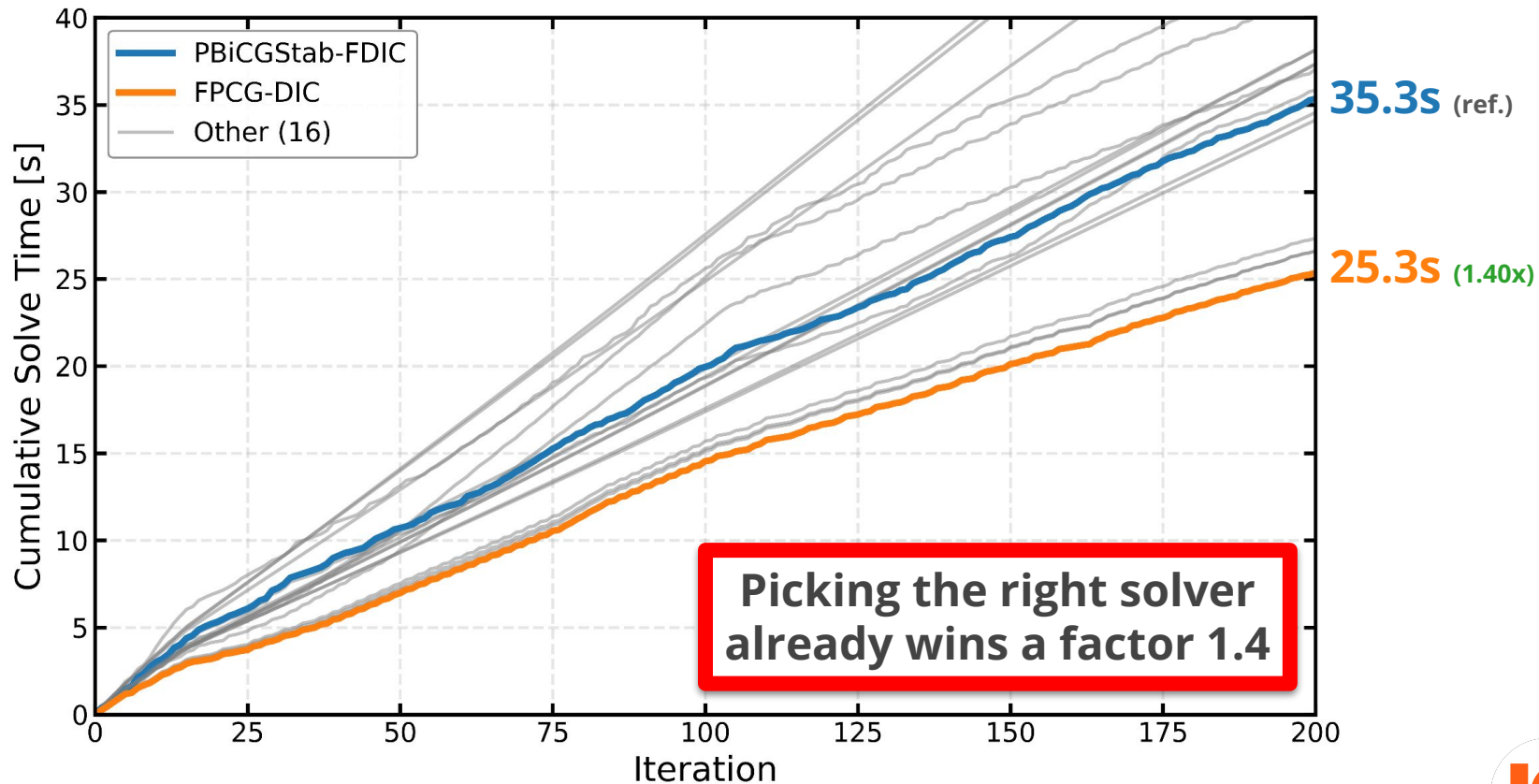
Steady-state solver

- Decoupled momentum, pressure and energy equation
- Iteratively solve for fixed number of iterations
- **>30% of simulation time spent in solving the pressure equation**

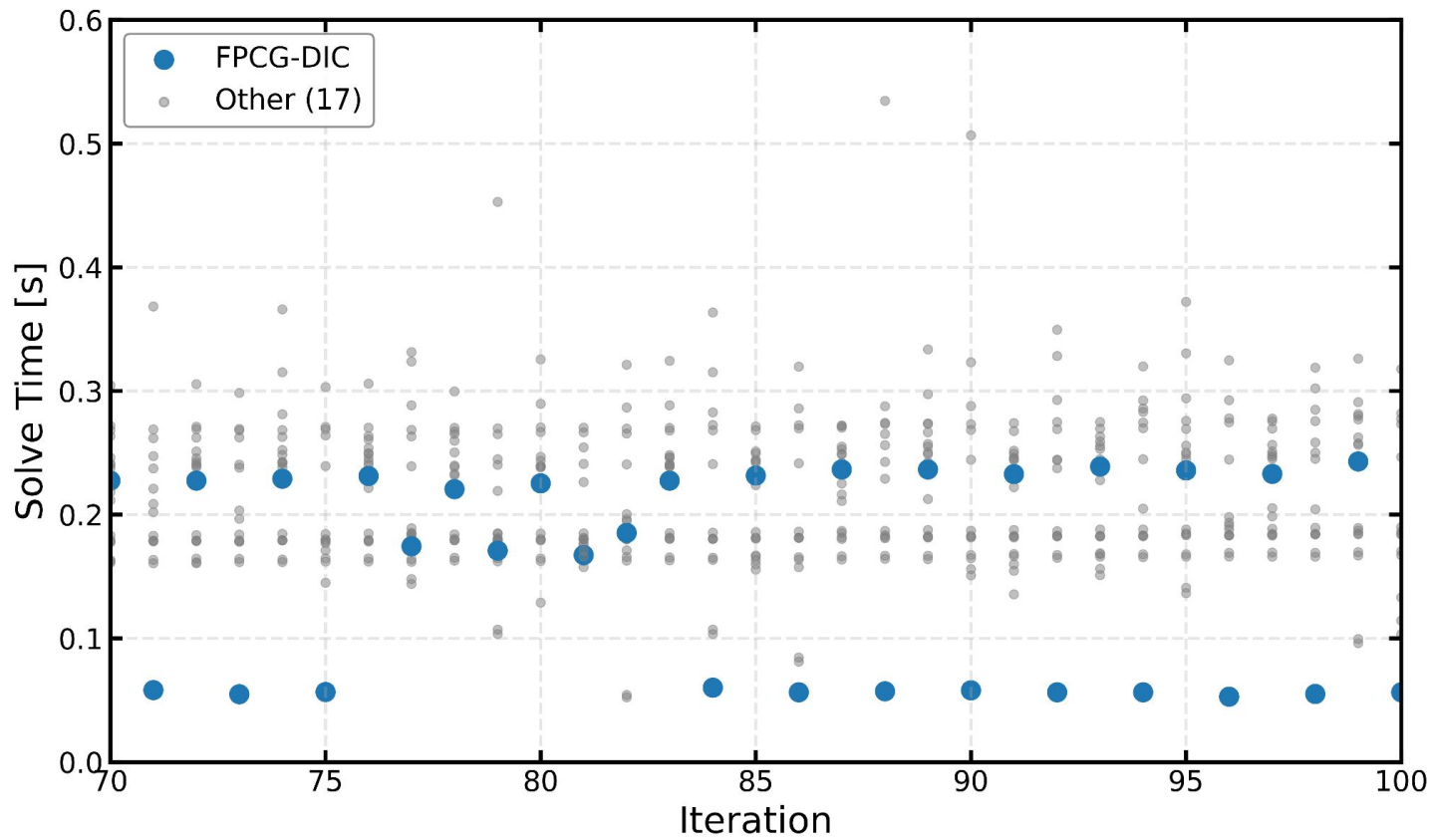
DEFAULT SOLVER



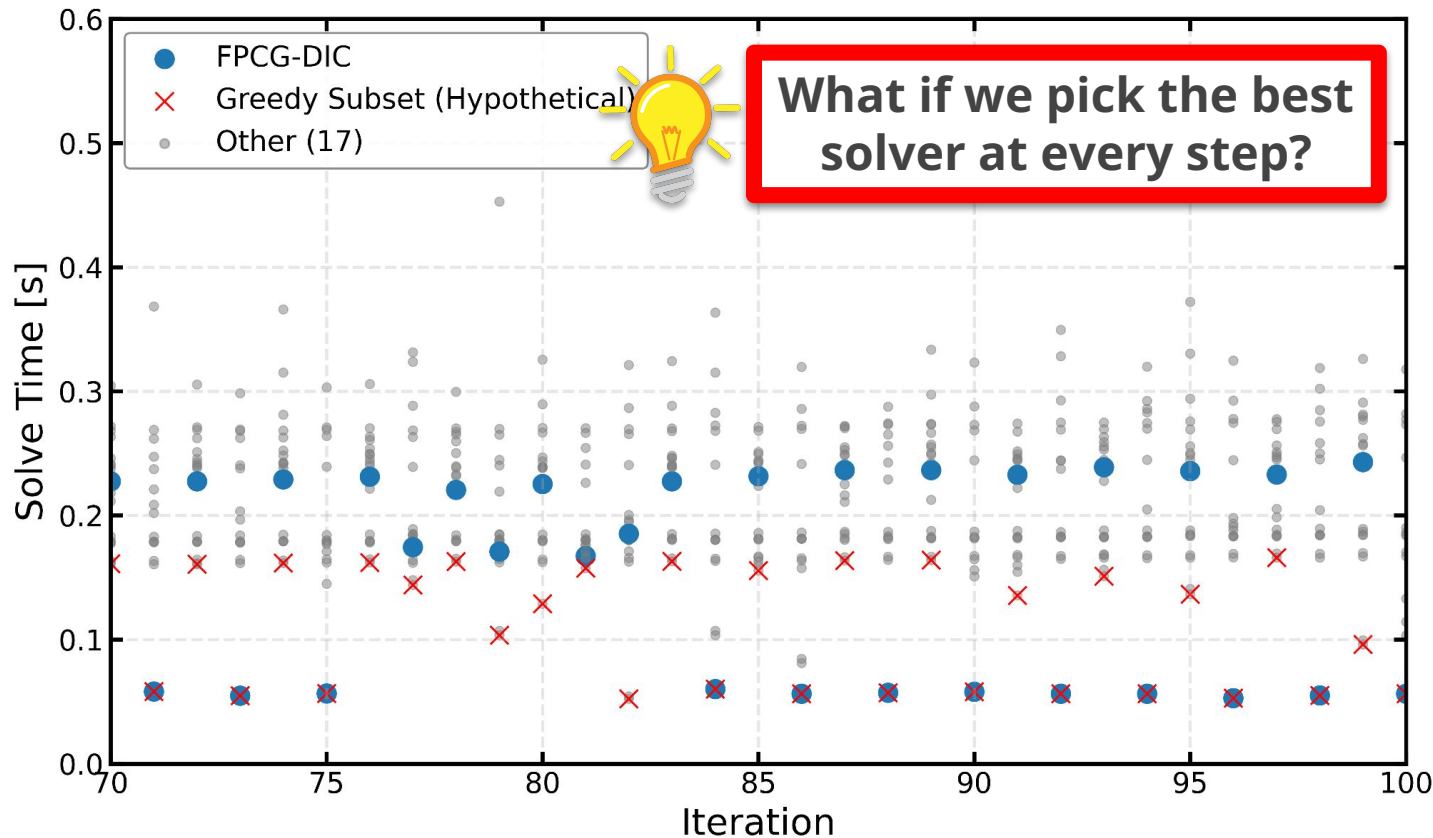
FASTEST SOLVER



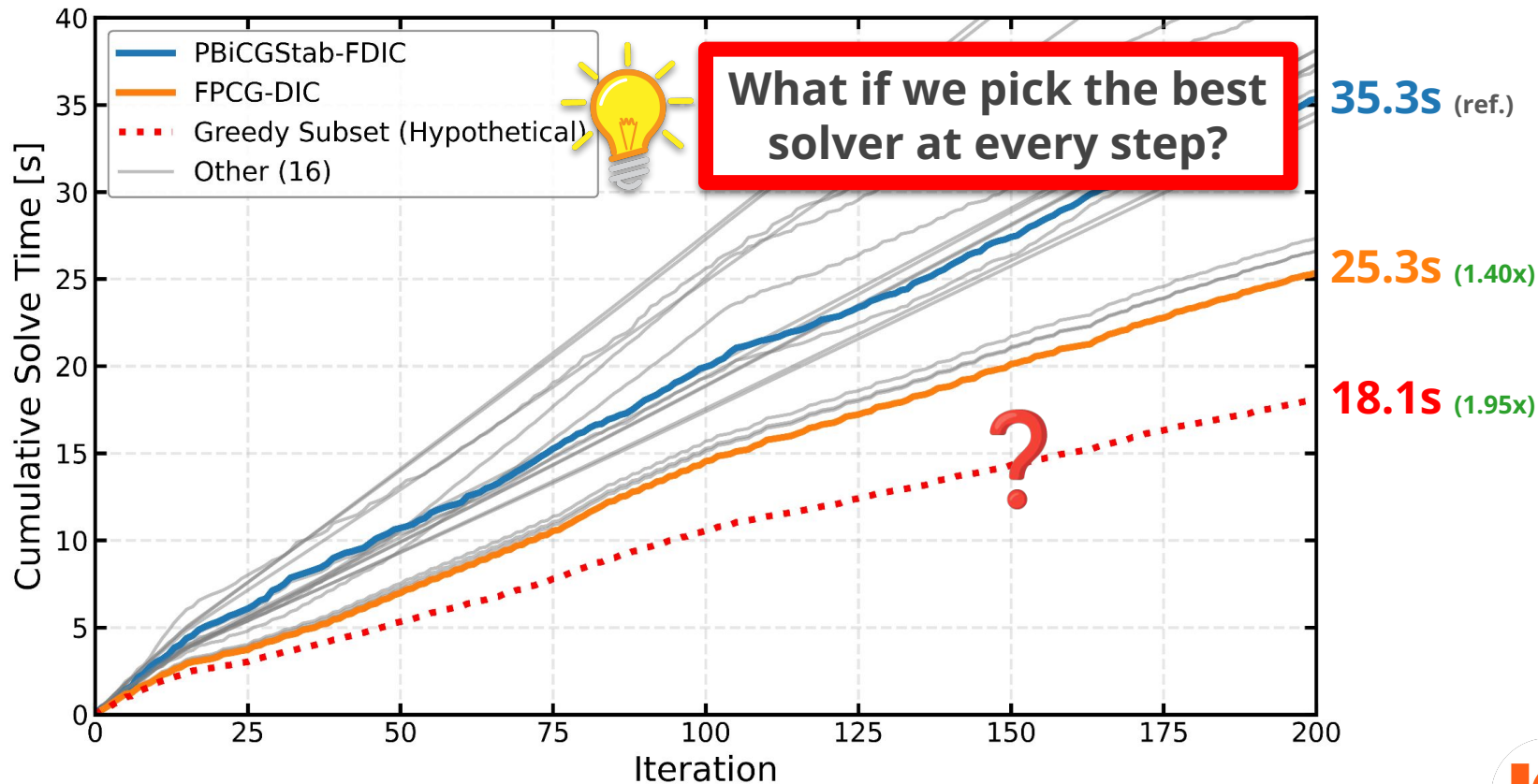
FASTEST SOLVER



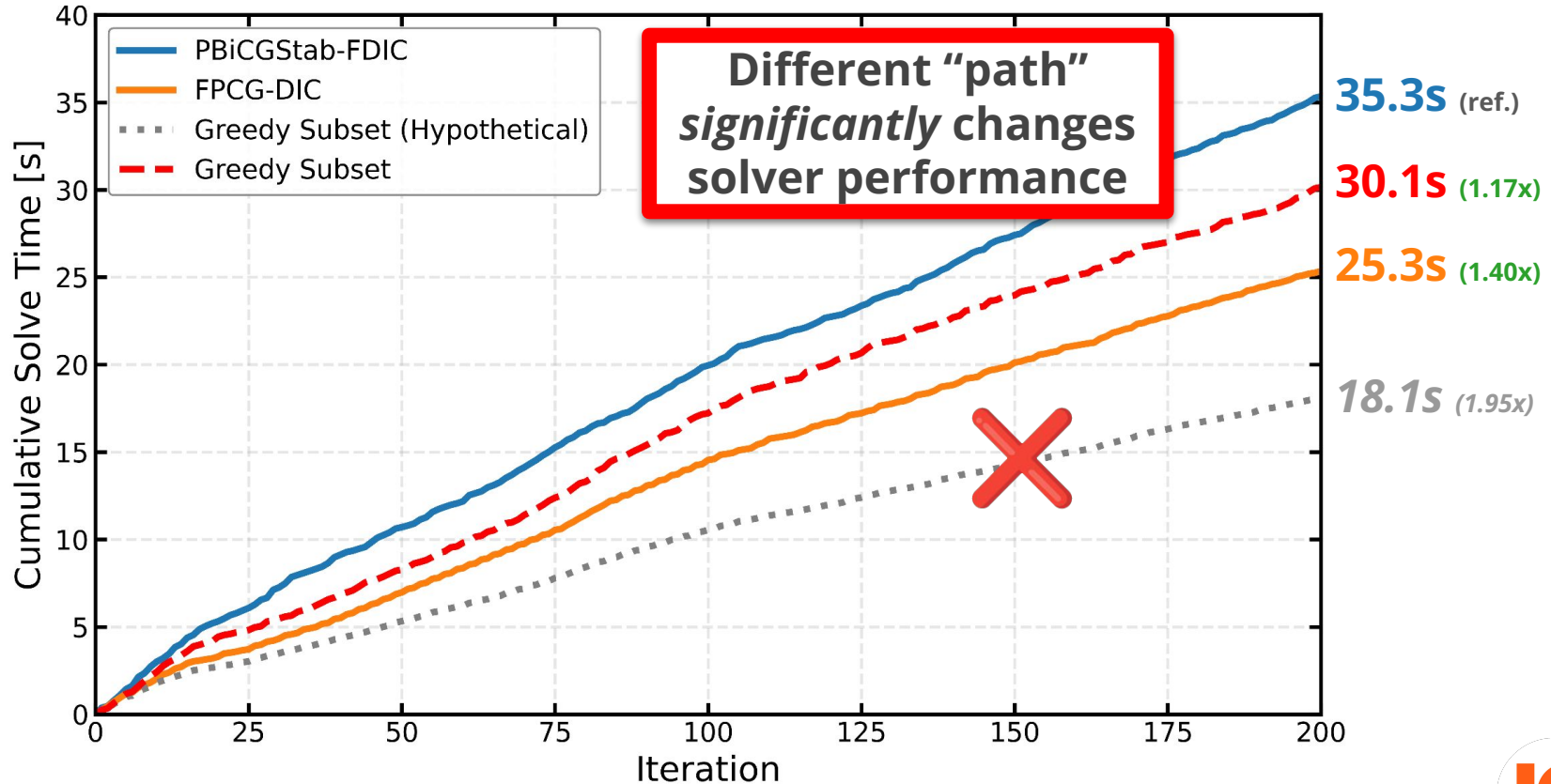
FASTEST SOLVER



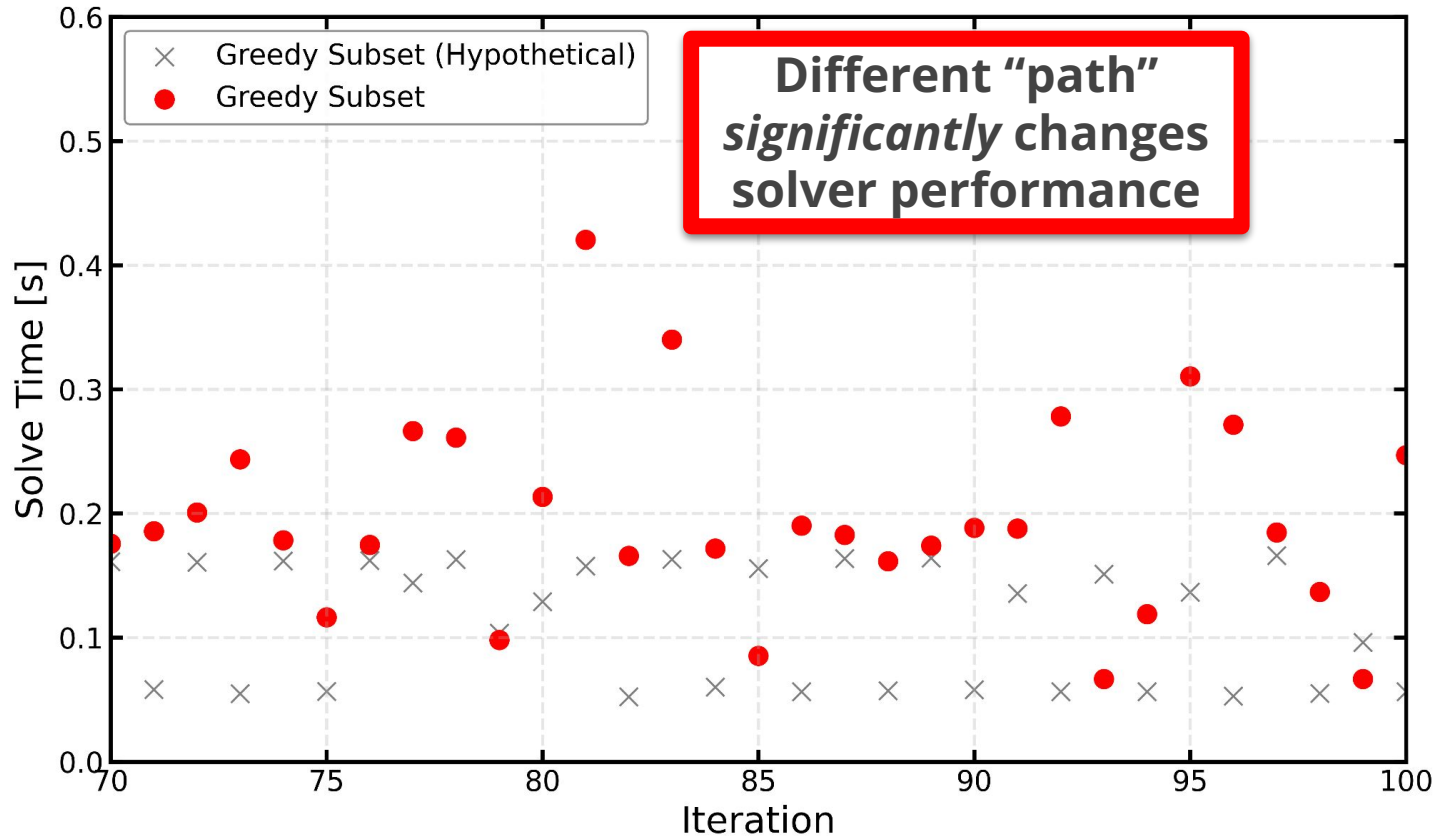
GREEDY SUBSET HYPOTHETICAL



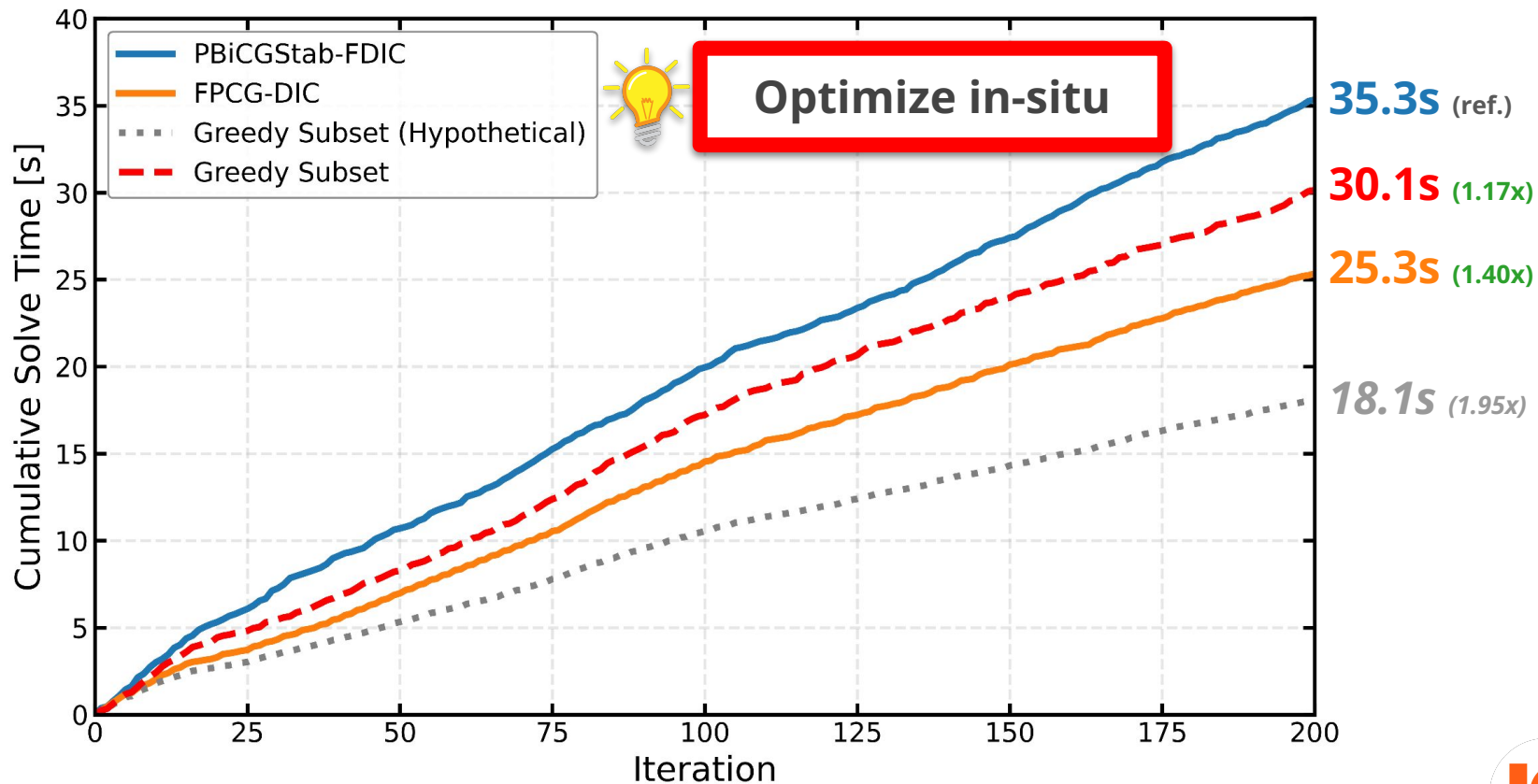
GREEDY SUBSET ACTUAL



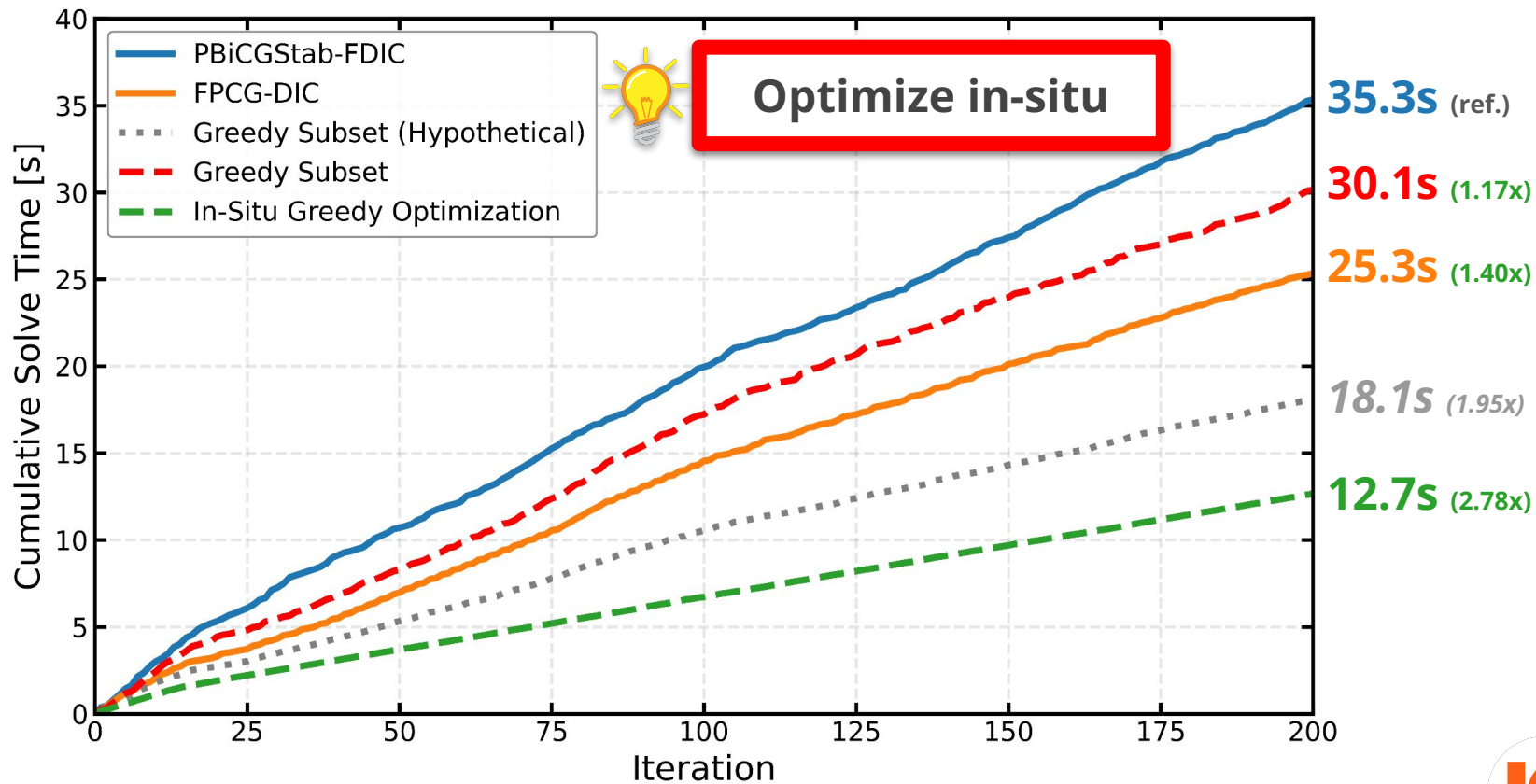
GREEDY SUBSET ACTUAL



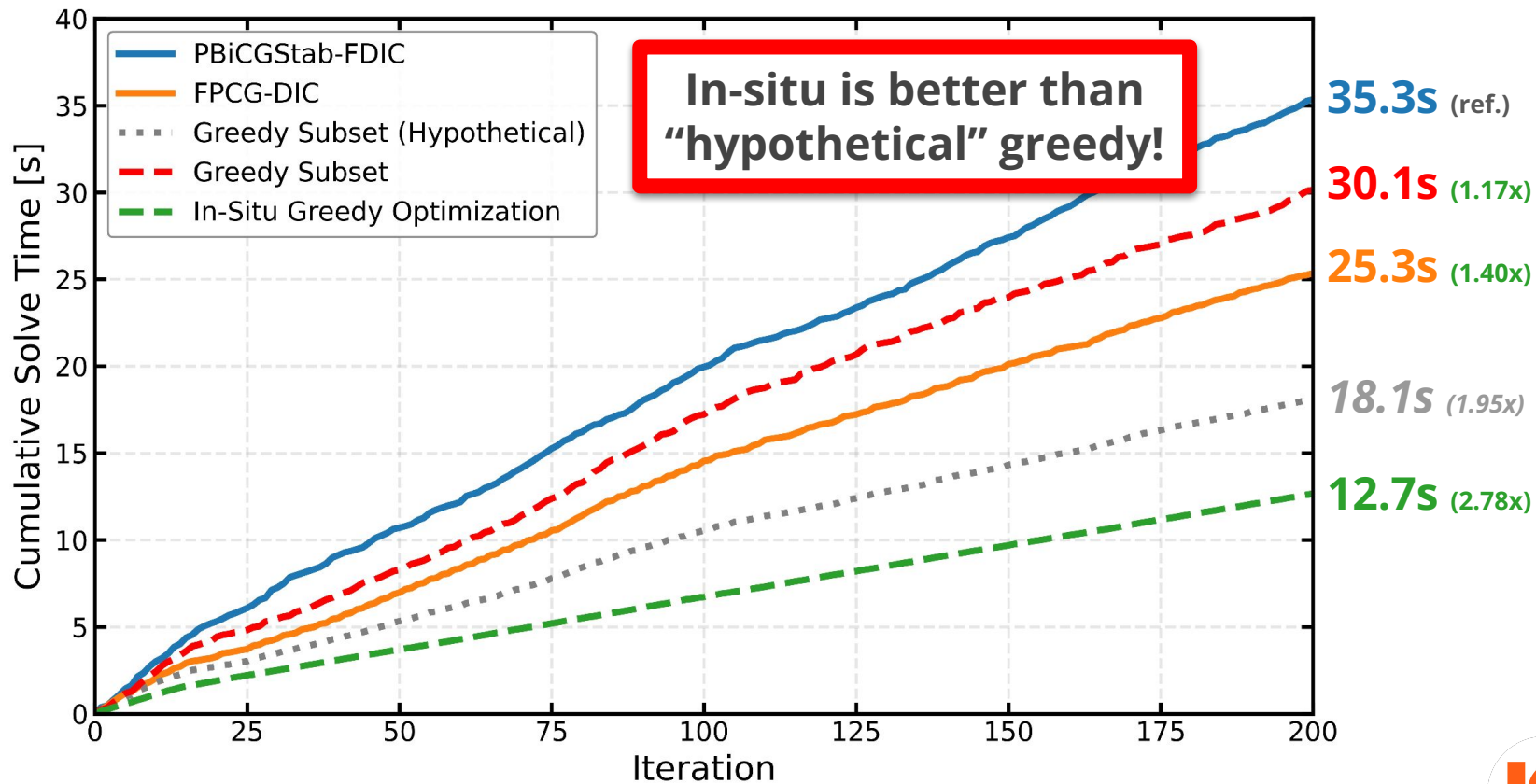
IN-SITU GREEDY OPTIMIZATION



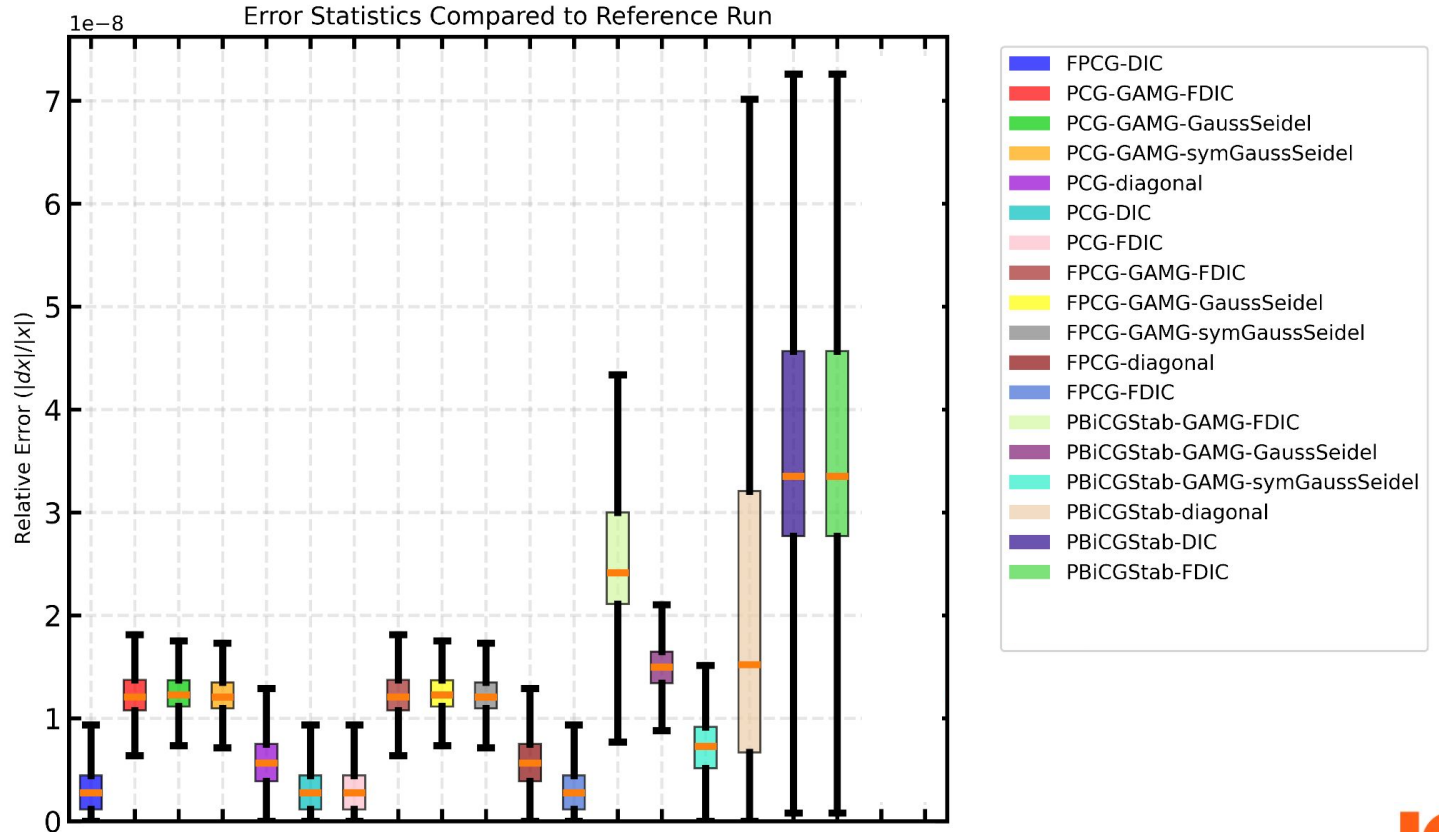
IN-SITU GREEDY OPTIMIZATION



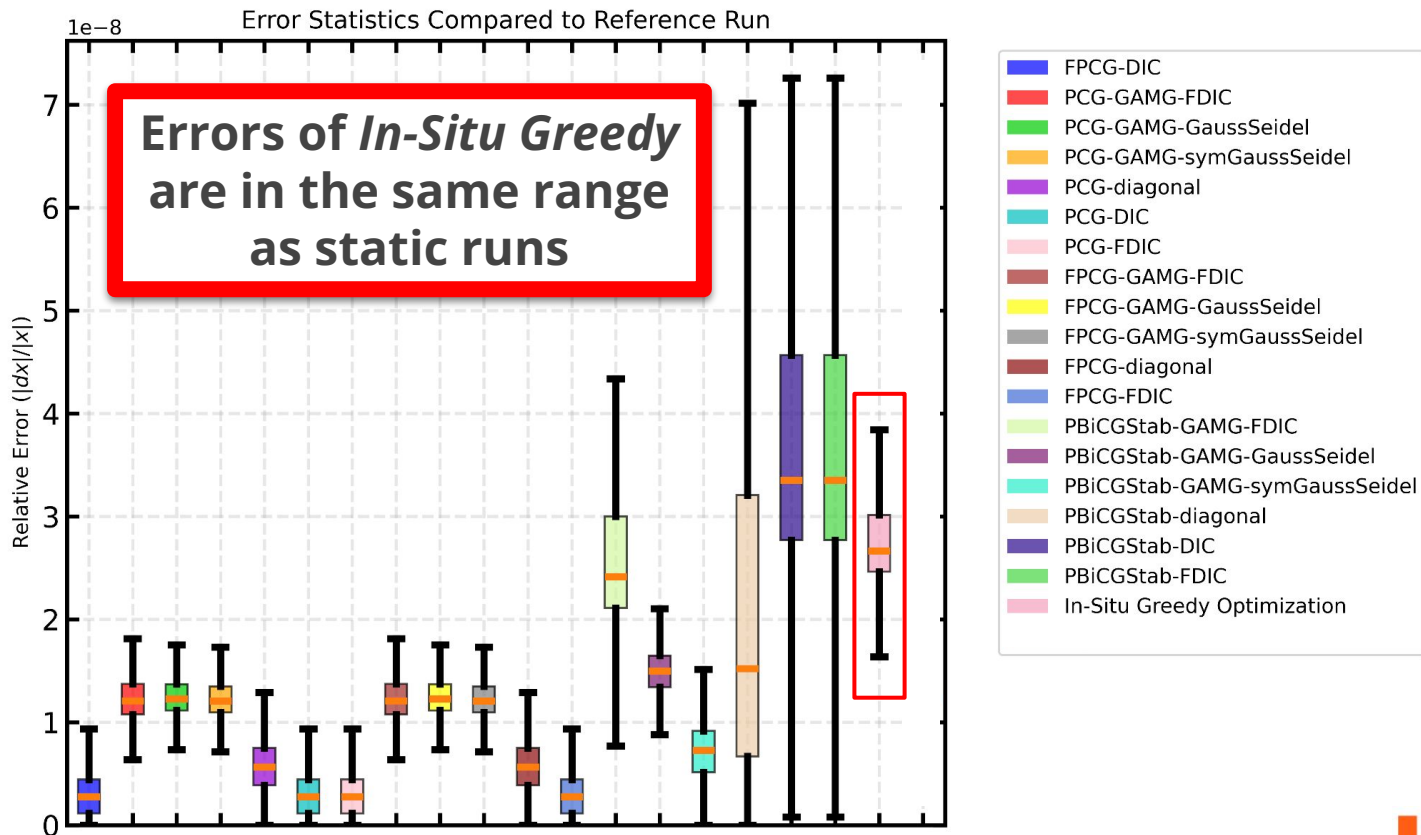
IN-SITU GREEDY OPTIMIZATION



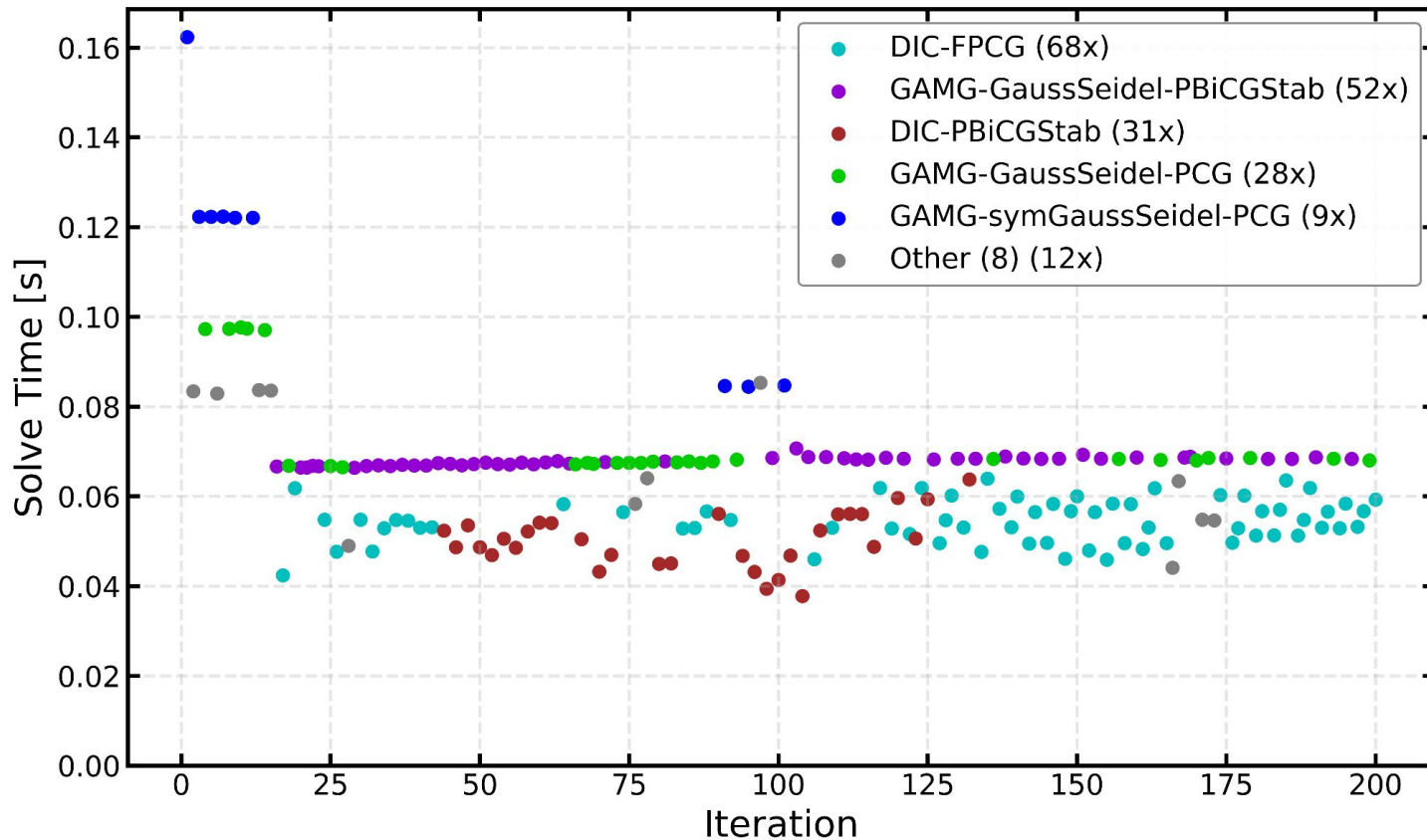
SOLUTION DELTAS



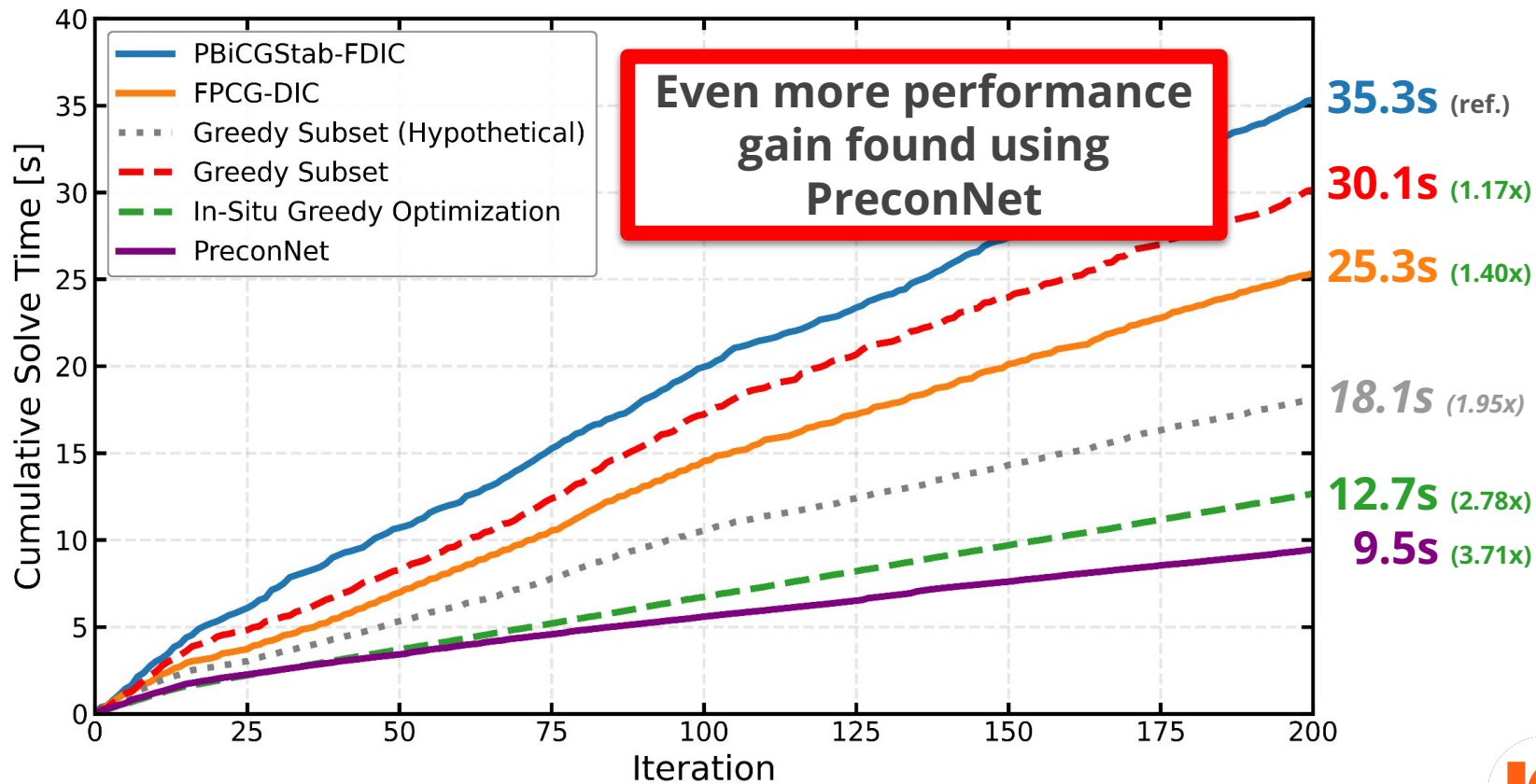
SOLUTION DELTAS



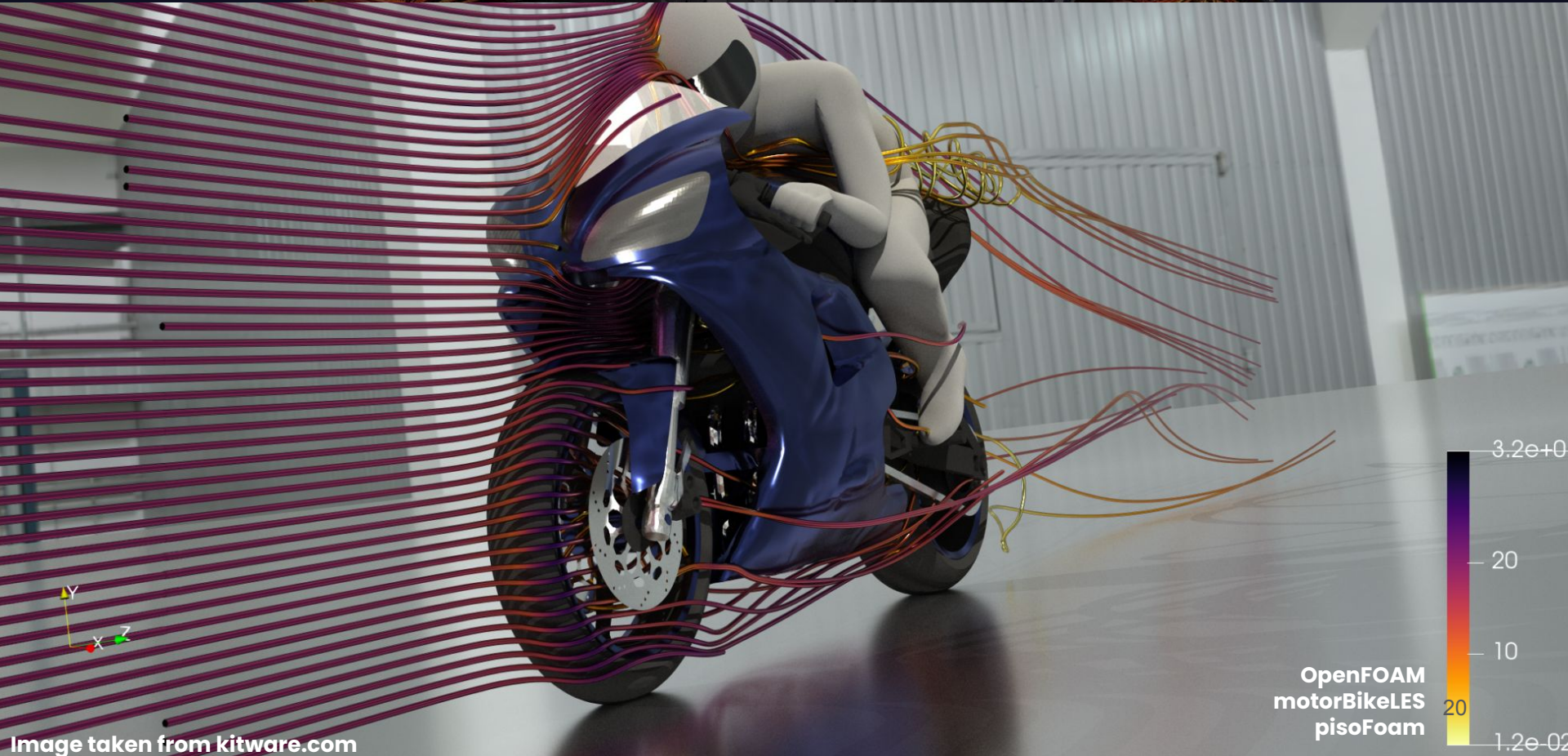
SOLVER CHOICE



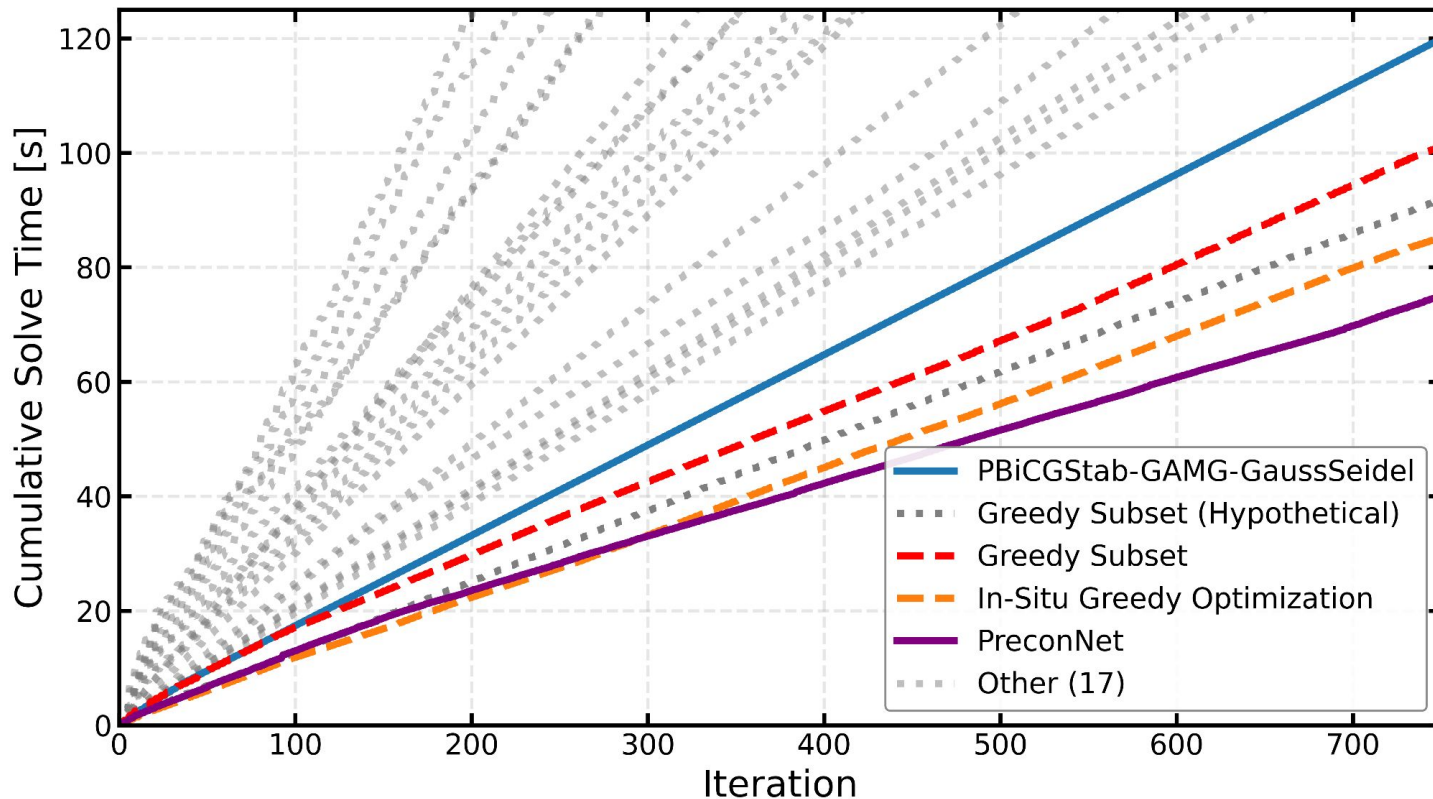
PRECONNET



MOTORBIKE



MOTORBIKE



120s (ref.)

102s (1.18x)

91.8s (1.31x)

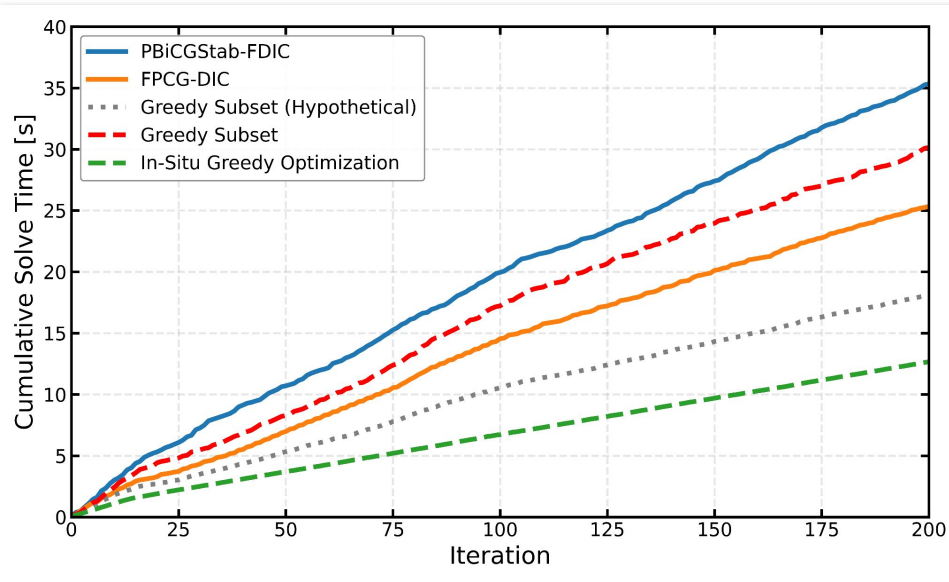
85.1s (1.41x)

74.9s (1.60x)

i 20-35% of the total simulation time is spend in this solver

CONCLUSIONS

*Dynamic Solver Selection can
Significantly Speed Up Simulations*



Solver performance is path dependent



Optimal path contains many different solvers



Daan van Vugt



Alan Cotino



Iris van der Werf



Yannick de Jong



Sebbe Blokhuisen



Koen Strien



Do you have an interesting case to study? Let's talk!

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