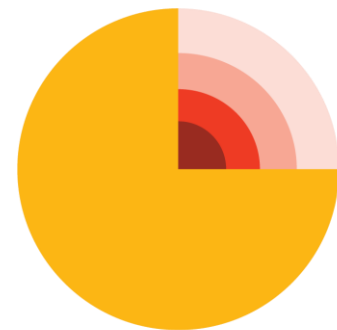


Tandem

Status of ChEESE-2P Flagship Codes



ChEESE



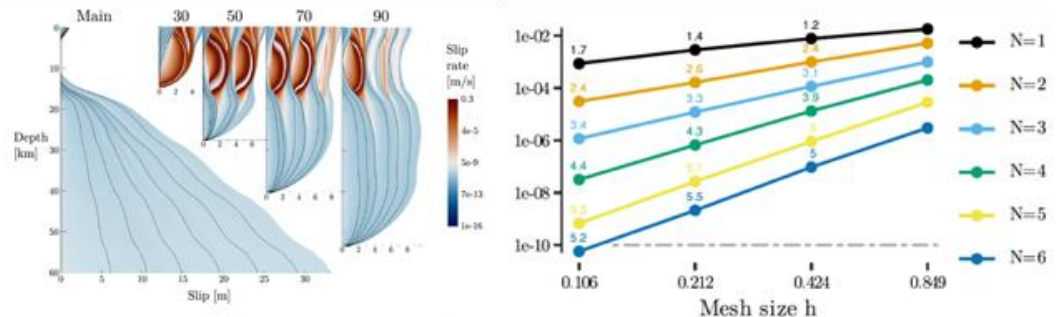
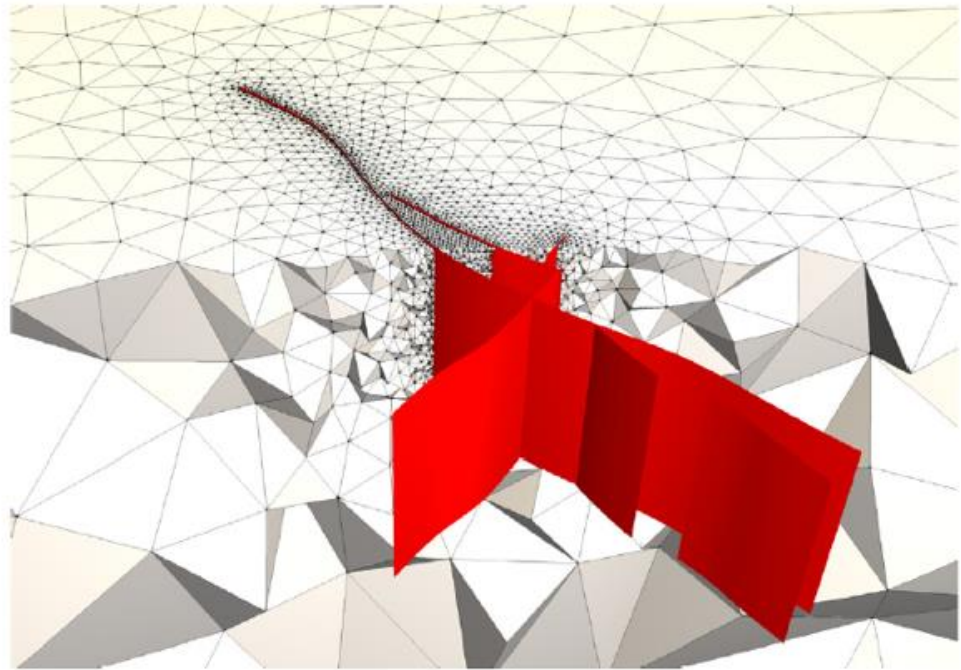
Tandem – Seismic Cycles

A discontinuous Galerkin method for sequences of earthquakes and aseismic slip on multiple faults using unstructured curvilinear grids

C. Uphoff, May, D.A.,
Gabriel, A.-A. *Geophysical
Journal International*, 2023.

Repository:

<https://github.com/TEAR-ERC/tandem>
(BSD 3-Clause License)





Tandem Team:

- Alice-Agnes Gabriel (LMU, UCSD)
 - **Casper Pranger (LMU, Tandem contact WP2)**
 - **PostDoc, TBD (LMU - we are hiring!)**
 - Dave May (UCSD)
 - Duo Li (LMU)
 - Nico Schliwa (LMU)
-
- Former, primary developer: Carsten Uphoff (PhD TUM, PostDoc LMU, now at Intel)



Tandem – all Tasks

- Discontinuous SIPG Galerkin method for elasticity with embedded faults.
- Curvilinear or affine geometries supported (meshing choice).
- Arbitrary polynomial degree (compile time choice).
- MPI parallel.
- Parallel loading, partitioning (via Parmetis) and distribution of GMSH files.
- Fast assembly and SpMV kernels through YATeTo (Yet Another Tensor Toolbox; Uphoff and Bader, 2020).
- Sparse linear algebra SLA via PETSc. SLA inherits PETSc GPU support (activated via a run-time option).
- Optimal linear solvers realized through p-multigrid + algebraic multigrid (AMG).
- Model description defined via Lua.
- Simulations require many time steps ($O(1e7)$).
- Portable checkpoint files generated.
- Output formats: Entire domain (pvtu), pointwise (ascii).



Performance Status Tandem:

- No systematic scaling campaign [yet]
- CPUs: tested up to ~ 5000 MPI ranks on SuperMUC-NG
- GPUs: tested on two GPU NVIDIA GeForce RTX 3090 (via PETSc)
- Conservatively, ~ 8 times speedup observed on single GPU
- Implementation has been tested on small multi-node, multi-GPU systems
- supports CUDA, HIP or OpenCL via PETSc
- ARM: missing YaTeTo support



Tandem Other Information:

- **Mini-app:** static solve, exists
- **Dependencies:**
 - YaTeTo
 - zlib
 - Eigen
 - Python with NumPy
 - Lua
 - CMake
 - METIS and ParMETIS
 - MPI (e.g. OpenMPI)
 - PETSc
 - libxsmm (optional)
- **ReadTheDocs Documentation:**
<https://tandem.readthedocs.io/en/latest/>

