Short History of GRIT

- The original idea of mixing implicit level-set interface tracking with explicit interface representation using simplicial complexes (triangle mesh) was the sole result of Andreas Bærentzen work.
- The idea where later extended to 3D in the deformable simplicial complex (DSC) method. The work was driven by Marek Misztal during his PhD and later post doc time at DTU. We strongly recommend his thesis as the main background source.
- As one of many demonstrator cases of DSC a multiphase liquid simulation was developed in collaboration between mainly researchers from DTU, UCPH and Alexandra Institute. This lead to a long series of simulation papers exploring and improving the DSC method. We perceive this work as helping mature the DSC method.
- After many years of experience with DSC the simulation researchers at UCPH meet the performance barrier of DSC in the simulation needs. This was the birth of GRIT. A parallel GRIT was first prototyped by master thesis student Mark Jensen.

History Contd.

- GRIT builds on the experiences from DSC, but is radical different in many aspects. Erleben and Misztal developed the algorithmic framework to overcome the sequential nature of the DSC method and the overhead in the DSC implementation at that time. Hence,
    - GRIT was designed to support domain decomposition through a copy-and-replace sub-domain strategy. Hence GRIT was born to support parallelism in at least a simple matter.
    - GRIT eliminated the sequential control flow in the original DSC algorithm by batching operations into categories. A movement operation batch, a vertex split operation batch, a relabelling operation batch, a refinement operation batch, a coarsening operation batch, smoothing operation batch, and optimisation operation batch. Leading to batching of similar computational operations that all could potentially be made parallel using a kind of red-black Jacobi blocking of the operations within a batch, but keeping batch execution sequential and synched.
- GRIT was designed to support custom quality measures for all batch operations
- GRIT was initially designed to support generic attribute vectors to support more easy adaption to various problems. Like defining a heat field, or a viscosity field or whatever field that needs to be included into the model.
- GRIT abstracted over the actual mesh implementation and math types by defining a mesh interface in terms of topological algebra operations on simplicial complexes and using a math type binder for easily swapping math types.
- DSC supported rollback mechanism which was abandoned in GRIT.