Using the Loop platform to Build Structurally Complex 3D Geological Models: Towards Better Resource Models?

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Loop is an innovative 3D geological modelling platform designed to build structurally constrained, data-driven, geological models. Loop integrates geological concepts with numerical methods, making it easier to create consistent, geologically realistic models. LoopStructural uses structural geology principles to interpolate surfaces and volumes, offering a flexible, open-source solution that can adapt to a wide range of complexly deformed geological settings. Loop also connects with other tools for geophysical inversion, uncertainty analysis, and visualisation, promoting a reproducible and scientific approach to geological modelling.

In LoopStructural, structural frames define a local coordinate system associated with a geological event, such as a folding event, a fault (or family of faults), an unconformity or an intrusion. Each frame consists of three orthogonal scalar fields related to the finite strain ellipsoid associated with each event; e.g., for fold, the principal shortening direction (perpendicular to the axial surface), the principal extension direction (usually perpendicular to the fold axis and parallel to the axial surface) and an intermediate direction (usually parallel to the fold axis) or for fault, a direction perpendicular to the fault surface, one direction parallel to the offset direction and the third direction being perpendicular to the other two. Structural frames allow Loop to model deformations histories in a time aware sense, meaning that the youngest event is be modelled first until the oldest foliations are modelled (usually bedding or lithological layering).

We demonstrate the capability for polydeformed terrane modelling in Bermagui, a well-known area for structural complexity and exhibiting multiple folding events. The model will be built progressively using field observations of overprinting relationships between dissolution cleavages in sandstones and crenulation cleavage in mudstone of the Ordovician-Silurian turbiditic sequence. Finally, we show how the frame could be easily and meaningfully applied to geostatistical methods and property simulation in complexly deformed geology.