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geomIO: A tool for geodynamicists to turn 2D cross-sections into 3D geometries

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In numerical deformation models, material properties are usually defined on elements (e.g., in body-fitted finite elements), or on a set of Lagrangian markers (Eulerian, ALE or mesh-free methods). In any case, geometrical constraints are needed to assign different material properties to the model domain. Whereas simple geometries such as spheres, layers or cuboids can easily be programmed, it quickly gets complex and time-consuming to create more complicated geometries for numerical model setups, especially in three dimensions.

geomIO (geometry I/O, http://geomio.bitbucket.org/) is a MATLAB-based library that has two main functionalities. First, it can be used to create 3D volumes based on series of 2D vector drawings similar to a CAD program; and second, it uses these 3D volumes to assign material properties to the numerical model domain.
The drawings can conveniently be created using the open-source vector graphics software Inkscape. Adobe Illustrator is also partially supported. The drawings represent a series of cross-sections in the 3D model domain, for example, cross-sectional interpretations of seismic tomography. geomIO is then used to read the drawings and to create 3D volumes by interpolating between the cross-sections. In the second part, the volumes are used to assign material phases to markers inside the volumes. Multiple volumes can be created at the same time and, depending on the order of assignment, unions or intersections can be built to assign additional material phases. geomIO also offers the possibility to create 3D temperature structures for geodynamic models based on depth dependent parameterisations, for example the half space cooling model. In particular, this can be applied to geometries of subducting slabs of arbitrary shape.

Yet, geomIO is held very general, and can be used for a variety of applications. We present examples of setup generation from pictures of micro-scale tectonics and lithospheric scale setups of 3D present-day model geometries.