Three-dimensional structural modelling of fault drag

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Fault drag in two dimensions refers to the deflection of curved markers adjacent to a fault in plane sections. *Normal drag* refers to markers that are convex in the direction of slip, and *reverse drag* to markers that are concave in the direction of slip.
Whereas fault drag is frequently used as a descriptive term Coelho et al (2005) tried to quantify the curvature of fault drag in more detail by using Bézier curves. Grasemann et al. (2005) described the magnitude of the curvatures in diopters, using osculating circles of the deformed marker line. The curvature in two-dimensions is described by a scalar (i.e. the inverse of the radius of the osculating circle), but the curvature at a point on a surface in three-dimensions is described by means of a second-order tensor (Lisle and Robinson, 1995). Therefore various tensorial quantities can be used to quantify fault drag: For examples curvatures of a surface can be measured on cross-sections of the surface made by planes which contained the line perpendicular to the tangent surface at *P*. The curvatures of these cross-sections are called the normal curvatures of the surface at *P*. The magnitude of these curvatures are strongly dependent on the directions of the cross-sections. The maximum and the minimum of the normal curvatures are called principal curvatures, which are always found on perpendicular cross-sections except the normal curvatures of the surface are constant. However, the normal curvature is an extrinsic geometric property of the surface. For the description of fault drag, the Gaussian curvature (i.e. the product of the principal curvatures) of a surface, which is not related to the topological properties but is intrinsic to the surface and independent of how it is embedded in space, might provide a better parameter. Another measurement of curvatures in three-dimension is the mean curvature of a surface, which measures the average principal curvature of the normal curvatures. Although this value is a measure of how much the surface is curving, it cannot be directly related to the curvature and thus the fault drag of a curve in two-dimensions.
Currently fault drag is not defined in three-dimensions. A three-dimensional structural model of a natural fault system associated with three-dimensional fault drag demonstrates the importance of quantification using differential geometry.

Coelho, S., Passchier, C. & Grasemann, B. 2005. Geometric description of flanking structures. Journal of Structural Geology 27, 597-606.

Grasemann, B., Martel, S. & Passchier, C. 2005. Reverse and normal drag along a fault. Journal of Structural Geology 27, 999-1010.
Lisle, R.J. & Robinson, J.M., 1995. Mohr circle for curvature and its application to fold description. Journal of Structural Geology 17, 739-750.