## Abstract

Well-established models of folds in structural geology rely on the description of surfaces as cylindrical folds. The main geometrical information is therefore reduced to two dimensions. The increasing availability of large three-dimensional data sets through seismics, GPS, remote sensing techniques etc., created an opportunity for a thorough description of general non-cylindrical folds. In recent years, methods from differential geometry have been applied to study and classify general geological surfaces. For example, three-dimensional descriptions based on curvature analysis allow to not just distinguish between synforms and antiforms, but also include the description of saddles, domes and basins. Quantitative and qualitative curvature studies enable to draw conclusions about the evolution and mechanics of strained surfaces. Furthermore, the link between the distribution of curvature and fracture densities makes curvature analysis applicable to the exploration of oil and gas fields.

I begin this thesis with providing an overview of current research in structural geology that uses differential geometric methods. The mathematically relevant theories are introduced first, then various applications of such differential geometric methods in geology are discussed. I use these ideas to develop a MATLAB code for curvature computations of geological surfaces. The programs make it possible to not just compute but also visualize curvature quantities and surfaces in various ways. Folded surfaces can automatically be classified with respect to the so-called geological curvature.

In the final part of the thesis, a small area of the Zagros Mountains in North-East Iraq is studied. Curvature analysis are carried out around the Safeen Anticline using the above mentioned MATLAB code. The generated images are interpreted in view of their structural geological properties. From this discussions it becomes evident that modern geometrical theories are indeed a fruitful tool for applications in geology.