Topological Methods for the Representation and Analysis of Exploration Data in Oil Industry

The purpose of Exploration in Oil Industry is to "discover" an oil-containing geological formation from exploration data. In the context of this PhD project this oil-containing geological formation plays the role of a geometrical object, which may have any shape. The exploration data may be viewed as a "cloud of points", that is a finite set of points, related to the geological formation surveyed in the exploration experiment. Extensions of topological methodologies, such as homology, to point clouds are helpful in studying them qualitatively and capable of resolving the underlying structure of a data set. Estimation of topological invariants of the data space is a good basis for asserting the global features of the simplicial model of the data. For instance the basic statistical idea, clustering, are correspond to dimension of the zero homology group of the data. A statistics of Betti numbers can provide us with another connectivity information. In this work represented a method for topological feature analysis of exploration data on the base of so called persistent homology. Loosely, this is the homology of a growing space that captures the lifetimes of topological attributes in a multiset of intervals called a barcode. Constructions from algebraic topology empowers to transform the data, to distillate it into some persistent features, and to understand then how it is organized on a large scale or at least to obtain a low-dimensional information which can point to areas of interest. The algorithm for computing of the persistent Betti numbers via barcode is realized in the computer algebra system "Singular" in the scope of the work.