SUB-IMAGE ANALYSIS USING TOPOLOGIAL SUMMARY STATISTICS

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We propose a Sub-Image aNAlysis using Topological summaRy stAtistics (SINATRA) framework for pipelining image analysis, with the aim of understanding what differences in shapes constitute to changes in regression outcomes. The pipeline consists of four steps. The first step is to transform the shapes into functions with the Euler Characteristic Transformation (ECT)[1]. This makes the shapes amenable to the tools of functional data analysis. The second step is to fit a Bayesian Gaussian process classification model on the transformed shapes. The third step is to assign a non-linear, Kullback-Leibler divergence based importance metric called Relative Centrality (RATE)[2] to the classification model. The importance metric allows us to do association mapping to perform feature selection on the Gaussian regression model. Finally, we devise a partial inverse Euler Characteristic Transformation formula inspired by the finite injectivity result of ECT proved in [3]. We use the inversion formula to pull back the selected features to the shapes, which allows us to infer what features of the shape were associated with the classification decision. The main contributions of this work are the integration of steps one to four to a image-analysis pipeline, and the discretization of the theoretically satisfying results to drive concrete applications.

References

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