STREAMING ALGORITHM FOR EULER CHARACTERISTIC CURVES OF MULTIDIMENSIONAL IMAGES

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In various applications, including material science, medical imaging, and astrophysics, there is need to analyze high resolution images coming from various types of scanners. In particular, modern micro-CT-scanners produce three-dimensional images with up to 10^{12} voxels. Available implementations of topological descriptors, including persistent homology, are not efficient enough to handle such datasets. As an alternative, we propose a simpler topological descriptor, namely the Euler characteristic curve.

Viewing a gray scale image as a function from the voxels to the gray intensity values, the Euler characteristic curve of the image maps each such value to the Euler characteristic of the corresponding sublevel set. The Euler characteristic curve can be seen as a summary of the Betti curves as well as a summary of persistent homology.

We developed the first algorithm to compute the Euler characteristic curve of images of arbitrary dimension that is time- and memory-efficient enough to handle images with more than 10^{12} voxels [1]. The software—CHUNKYEuler—is available as open source: https://bitbucket.org/hubwag/chunkyeuler.

Joint work with Hubert Wagner.

References

[1] T.Heiss and H.Wagner: *Streaming Algorithm for Euler Characteristic Curves of Multidimensional Images*, In: Computer Analysis of Images and Patterns. CAIP 2017. Lecture Notes in Computer Science, vol 10424. Springer, Cham, 2017, pp. 397–409.

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