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FINAL REPORT

AOF skeletonization package for python

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Abstract:

This project focuses on developing the pip package in Python, which is used to generate images with 2D AOF skeletons. This assignment necessitates a thorough knowledge of Linear Algebra and geometrical principles. The Flux Graphs for 2D Shape Analysis have had a significant impact on this project. The average outward flux (AOF) of the gradient of the Euclidean distance function to the boundary of a 2D object across the boundary of a smaller region is used in this project to compute skeletal representations.

Introduction:

The medial representation describes an item as a collection of singularities or quenches points computed from its border of the grassfire transform. The loci of medial points within the object produce arcs around which the object's contour is locally mirrored symmetrically. Each point in the object's interior is the result of two separate boundary points colliding. The union of the centers of the spheres that contact the boundary at two or more locations can also be seen as the set of medial points. In other terms, a medial axis is a set of points inside an object's boundary that are equidistant from two more points on the object's boundary. In a variety of applications (ie. Computer Vision, Medical Imaging), medial axes are used.

It demonstrates how the original approach proposed by Dimitrov et al. may be improved and made more efficient, as well as a faster methodology for computing flux invariants. It also takes advantage of a relationship between the AOF and the object angle at the skeleton's endpoints, branch points, and regular points to get more thorough boundary reconstruction findings than previous studies. New skeleton simplification methods are proposed using this optimized implementation, based on two criteria: the uniqueness of an inscribed disc as a tool for establishing salience and the limiting average outward flux value.

A number of graph complexity measures, such as the number of nodes, edges, graph depth, number of skeletal points, and the sum of topological signature vector (TSV) values, show that the simplified skeleton, when abstracted as a directed graph, is far less complex than popular skeletal graphs in the literature, such as the shock graph. The thesis comes to a close with the application of the simplified graph to a view-based object recognition experiment that had previously been set up for shock graphs. Our new simplified graph appears to produce recognition scores that are quite similar to those achieved with shock graphs, but with a reduced number of nodes, edges, and skeleton points.

Literature Review

We're making a 2D medial axis skeleton image for this project. Our Community partner devised a method for calculating skeletal representations based on the average outward flux (AOF) of the gradient of the Euclidean distance function to the boundary of a 2D object across the boundary of a smaller region[1]. To use this technique, first convert the input image to a distance image that we can process using distance functions. We may construct a distance function gradient vector field based on the distance image using the distance image.

The AOF value for each point on the image may then be computed by forming a circular area around them; the AOF value for points not placed on the skeleton is zero, while those with a non-zero AOF value can be seen as skeletal points. A skeleton image can be formed by filtering these skeletal points with a threshold. The flow invariants created by Dimitrov et al have been enhanced by this skeletonization method based on AOF, which performs many times faster. Furthermore, it outperformed some non-AOF-based skeleton algorithms in terms of accuracy.

In addition, our community partner's new simplified graph produces recognition scores that are remarkably similar to those achieved with shock graphs, but with fewer nodes, edges, and skeleton points.

The project design is no longer relevant to the project's current status. The goal of this project is to produce a python function pip package based on our community partner's source code and algorithm.

Discussion

Although we have completed a prototype of the 2D pip package for Python, our stakeholders have provided us with input on the package's current condition.

For starters, more selection options for potential users may need to be included, such as options for printing mid-process photos such as the three distinct versions of distance images, for even flux-based images, as well as a grayscale version of the input RGB image. Users must also supply versions of the output skeleton image, stating whether the required output should be inverted or a combination of the original and inverted skeleton. In addition, the user may need data or metrics from the algorithm in order to obtain more information about the transform.

The algorithm's second modification is to speed it up by increasing its processing RAM in return for its temporal complexity. For larger photos, such as those with a size greater than 1000*1000, the existing package has a long processing time, and the optimization might potentially lower the complexity from N3 to N while increasing memory by the same amount.

The next step is to optimize the package's inner variables, which includes deleting unnecessary imported functions and reorganizing variables to improve readability.

There are also potential improvements not stated by the community partner, which we may be able to do after the package has met the minimum standards.

Comments can be a useful addition to a package to provide thorough instructions on how to use a function or to help users understand the variables. More picture kinds can be added to the input, and formats like jpg may be accepted by the upgraded function. Finally, thorough documentation may be required to instruct users on how to utilize this package effectively.

Conclusions

We finished our mathematical examination of the 2D AOF skeleton transform in our first term, and our community partner exposed us to his algorithm in his thesis. In addition, we examined the Matlab and Python versions of our community partner's 2D skeletonization code and talked with him about how to turn the work into a package.

We finished constructing a prototype version of the 2D skeleton package and received feedback from our community partner on how to improve it further, which is detailed in the discussion section.

In order to meet the needs of our community partner, we will complete the creation of the 2D version of the skeletonization package in the near future. In order to meet the needs of our community partner, we will complete the creation of the 2D version of the skeletonization package in the near future.

Then, using the Matlab version of the technique, we'll create a 3D version of AOF skeletonization. We can begin to modify the package to provide more functionality or raise its usability when we finish the project's objective, the 2D and 3D AOF skeletonization package, by adding other input formats and choices or attempting to optimize the algorithm's space or time complexity.

References

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