Front propagation using fast marching in R

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Image segmentation is one of the most important challenges in computer vision since all the other steps in pattern recognition depend on the definition of regions of interest. Among the algorithms for image segmentation, level sets and fast marching have been used frequently in problems in shape recovery. A drawback of level sets is its computational expense, particularly when considering scripting languages. We implement the Fast Marching method in R, a numerical technique for solving the Eikonal equation as a boundary value problem without iteration over the whole data. In this scheme, a front advances monotonically with a speed function that never changes sign, such that the marching method efficiently computes the arrival time at each grid point by modeling a moving interface under an inward or outward motion. We illustrate bellow the method using a single seed and multiple seeds in a constant velocity field.

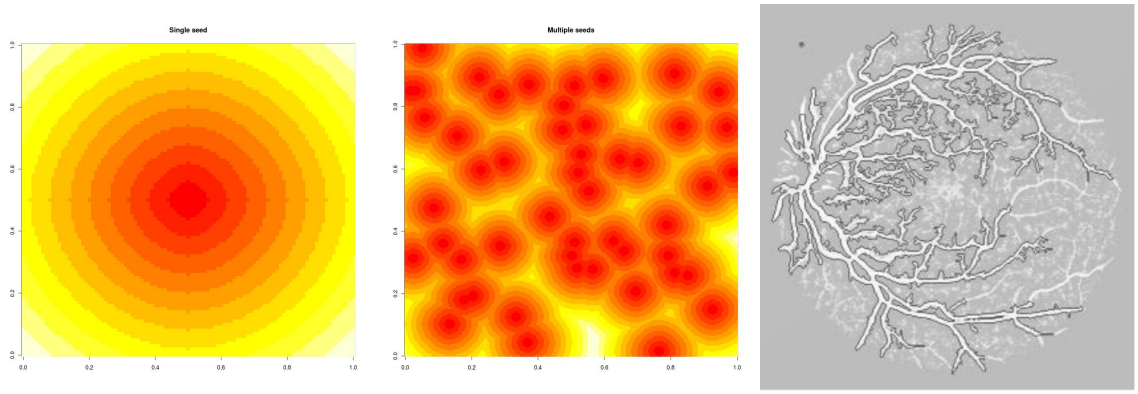

Figure 1: Front propagation given a single seed (left) and multiple seeds (center) in a constant velocity field and application of front propagation to biomedical images (right).

This implementation requires the following R packages: **PolynomF** for solving the quadratic polynomial in the fast marching method. Extensions could consider **biOps** for image filtering and mathematical morphology to provide more sophisticate speed functions. Future work include the use a C++ heap data structure, which characterizes FM fast capability of solving the equation in O(nlogn) and encapsulate the code into a package to be available.

References

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