**Algorithm pipeline**

|  |  |
| --- | --- |
| **Input:** | I: A gray-scale image of cellular solid;  T: The error threshold to terminate the loop  e: initial error |
| **Output:** | D: A power diagram that fits the image of cellular solid |
| **1:** | Define bounding domain S from image I |
| **2:** | Extraction of two skeletal point set from the void and the solid and denote them Q and P, respectively |
| **3:** | Initialize a point set X from Q |
| **4:** | Two-step Optimization Loop,  repeat if e < T |
| **4-1:** | D <-- PowerDiagramGenerator(X, Domain) |
| **4-2:** | D <-- Reconstructor(P, D) |
| **4-3:** | X+ <-- MeshOptimizer(D, X) |
| **4-4:** | e <-- norm(X+-X) |

**Three key components:**

* PowerDiagramGenerator: generate from X a clipped power diagram, D, bounded in S
* Reconstructor: update D such that D is a good reconstruction of P
* MeshOptimizer: optimize X to generate D

**Challenges:**

**Q1: Initialization of X and how many X we need?**

A1: This can refer to the very beginning report of mine, which states a method that decomposes the domain into quads using Voronoi decomposition.

An asymmetric issue occurs and cannot be handled by my previous proposal because the previous method desired to delineate the material interface by Voronoi decomposition computed by the two sets of skeletal points.

This time, I use only one set of the skeletal points, and assume the materials to be cellular solid which presents more regularity in its shape.

**Q2: How many sites in X should we initialize?**

A2: This shouldn’t be a problem since what we rely on is the power diagram that can make useless sites hidden by adjusting their weights. What we need to do is to ensure that the MeshOptimizer can reliably adjust the weights of sites.

**Q3: A1 gives a very good initialization for generating the diagram. If we do not have a very good initialization in some extreme cases, can we solve the problem as good as possible?**

A3: In what situation we may end up with a poor initialization? In situations where the maxima of the gray-scale scalar field are cluttered or where the gray-scale image is in 3D.

**What is the logic of doing this?**

1，简单的voronoi decomposition不能满足需求：让所有的x（单纯形顶点）位于其中一个骨架之上，而让所有的c（单纯形的对偶）位于另外一个骨架之上，从而描述所给定的材料的结构。

2，为了实现这一目标，我们希望通过采用power decomposition引入权重，去调节分割结果，使之满足上述需求。

3，我们首先采用其中一个骨架，得到一个点集X，计算voronoi剖分的结果，并得到一个对偶图（dual diagrams）。

4，然后我们人为地将所有的c点（也就是voronoi顶点，或者是单纯形的对偶点）放置到临近的另一骨架上。

5，根据这一约束，我们更新x的位置，并约束其位于骨架之上

6，根据更新后的x和c点的位置，我们求解w

7，反复迭代步骤5和6，直至收敛：x在约束方向上的变化接近于0，w的变化接近于0，或达到某个迭代次数上限。

8，根据更新后的x和w，计算新的RT，重复步骤4（及其后的步骤），直至重建误差小于某个给定阈值