# Order-independent interface reconstruction via Power Diagram in multi-material cells

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The interface reconstruction in mixed fluid cells filled with more than two materials is usually difficult without *ad hoc* assumption; as instance the onion skin model assumes an "order" in which materials must be processed by the algorithm, other methods might assume the "shape" of the interface in a pre-defined list of shape. Such an order might be in some case easy to define but in the general case it is not obvious and of course the shape list is by nature limited. Moreover a bad interface approximation generaly leads to bad advection of the fluids, hence to bad approximation of the solution.
Moreover, an erroneous interface reconstruction can lead to wrong materials advection, hence leads to inaccurate solution.

The purpose of our work is to develop an order-independent interface reconstruction for mixed cells having more than two materials. A type of particle method is first used to determine in mixed cells where each fluid/material is roughly located by using an attraction-repulsion particle system taking into account the particles in neighboring cells. The particles have the tendency to agglomerate and therefore define an approximate "centroid" for each fluid in the mixed cell. From the resulting particles agglomeration, we estimate a single approximate location point of each material. These location points are then used as the power diagram generator points. Using these generators, we developed a Power Diagram method, a kind of weighted Voronoi diagram, to actually deduce the locations of the interfaces between the fluids. The very interesting properties of such a coupled method are:

- it does not rely on an *a priori* order of material or fluids in mixed cells,
- it is independent of the dimentionality of the problem: "3D-easy",
- it is independent of the number of material in mixed cell.

We will present the theory and several numerical examples showing the efficiency of such a coupled method.