Knowledge Snippets: *Domain Vertex Method for solving complex geometries*

It is often difficult to comprehend solutions of problems that are not based in the Cartesian coordinates. This happens because the discretization scheme in the physical domain is unknown, without which we cannot use different techniques like the Finite Difference Method (FDM) and Finite Volume Method (FVM) to solve the differential equations. Hence, it is essential to find a way out to keep track of the discrete points inside the domain of interest. One of the simplest methods to do this is by implementing structured grids. The most popular methods used for structured grids are Domain Vertex Method (DVM) and Transfinite Interpolation Method, out of which the former would be the topic of discussion for this section. The Domain Vertex Method is a multidirectional interpolation method which maps the physical domain into a computational domain which is Cartesian in nature. In this method, select boundary nodes of the physical domain are defined based on the type of interpolation, i.e. 3 nodes per boundary for quadratic assumption, 4 nodes per boundary for cubic assumption and so on. Along with these nodes, blending functions are chosen according to the type of interpolation assumption, which can be determined by taking the tensor product of two separate unidirectional interpolation functions. Thus, the overall physical domain is successfully interpolated between 0 and 1 in the computational domain and a structured grid is created. When it comes to solving characteristic differential equations and corresponding boundary conditions that describe the entire problem, there comes a need to transform the coordinates, and this has to be done meticulously. Once this is done, the structured grid is subjected to FDM/FVM and thus with reasonable grid resolutions, one can obtain accurate results. Thus, in conclusion, the DVM hands in an efficient way to tackle complex geometry problems, which otherwise would be extremely difficult to solve using conventional solving methods. Some drawbacks of this method is that it would require multiple structured grids for unstructured problems. To tackle that, one shifts to either Delaunay triangulation, Advancing Front method or Quadtree/Octree methods. An example of the Domain Vertex Method can be viewed here.

References: Chung, T. J. (2014). Computational Fluid Dynamics, Second Edition, Cambridge University Press. Mazumder, S. (2015). Numerical Methods for Partial Differential Equations: Finite Difference and Finite Volume Methods, Elsevier Science.

-Aditya Ganesh (M20CH001)

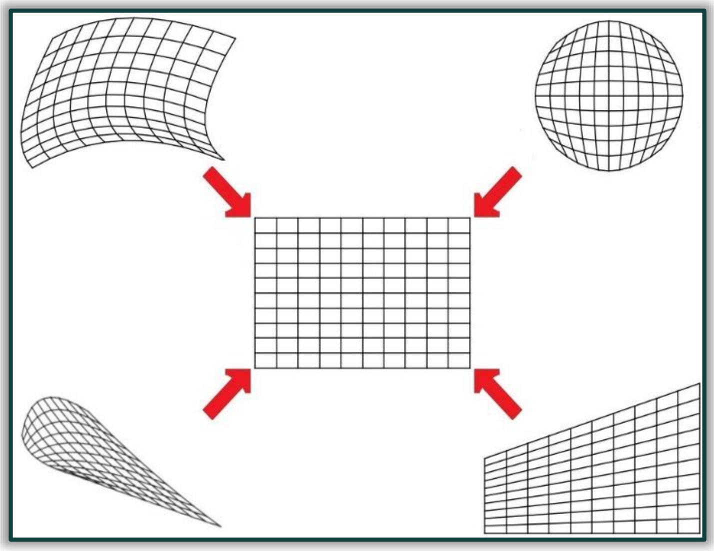

Figure 1. Interpolation of physical domain into a computational domain which is Cartesian in nature

Knowledge Snippets: Magnetic separation of iron impurities in powder extracts at *Umalaxmi Organics Pvt. Ltd. Jodhpur.*

M/s Umalaxmi Organics is a manufacturer of herbal formulations, active ingredient raw materials and bulk specialty ingredients for the nutraceutical, food, beverage & sports nutrition industries. It has a production facility in Jodhpur, producing botanical and herbal extracts. All the production facilities are GMP, ISO, HACCP, KOSHER, ORGANIC certified and the products are exported to international clients. The products are supplied to clients in powder form, maintaining strict quality control over the particle size distribution using a 40 mesh sieve. As per the requirement of the customers, the concentration of iron particles needs to be below 10 ppm in the extracts. To meet this quality criterion, magnets were used in the post-sieving process, but the iron content could only be reduced to 50-60 ppm. A root cause analysis was performed by Himanshu Ranjan (M20CH007). It was found that iron impurities seep into the product line during the manufacturing process, where the raw material used for the process has up to 100 ppm iron content. A new design of magnetic separation system was developed in order to achieve the target (<10 ppm iron impurities) and was approved by the director and the technical team of the company. The setup is under the procurement stage.

-Himanshu Ranjan
(M20CH007)