

# Everything You Always Wanted to Know About Mesh Quality But Were Afraid to Ask

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## **Abstract**

We analyze the joint efforts of the Geometry Processing and Numerical Analysis communities in the last decades to define and measure the concept of “mesh quality”. Researchers have been striving to determine how, and how much, the accuracy of a numerical simulation or a scientific computation (e.g., rendering, printing, modeling) depends on the mesh adopted to model the problem, and which geometrical features most influence the result. We overview the most common quality indicators currently used to evaluate the goodness of a discretization and drive mesh generation, coarsening, and refinement processes. We also present a mesh optimization algorithm based on these quality indicators, which analyzes local element quality and agglomerates elements to optimize global mesh quality. This significantly reduces the number of DOFs associated with a discrete problem defined over the mesh, particularly for high-order formulations, and regularizes low-quality meshes by removing pathological elements. We test this optimization algorithm in the context of Virtual Element Method (VEM), using a specific VEM quality indicator.

## **Keywords**

Mesh Generation, Mesh Quality, Numerical Simulations