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Efficient Spherical Numeric Integration in Multiple Dimensions[1]

MICHELLE JAMER, Seton Hall University — Numeric integration in three dimensions through approximation can be computationally intensive. Computers using numeric integration find an approximation of the integral by a finite representation. In order to make an accurate approximation, the computer uses many quadrature points in order to evaluate which causes the three-dimensional analysis to be time intensive. The goal of this research is developing a quadrature rule which would use fewer points and thus reduce the computational expense in both two and three dimensional contexts. The research for the most efficient rule is done by testing various numerical integration rules, such as the midpoint rule and Simpson's rule, in the Python programming language. For this project the focus is on symmetrical domains such as spheres and circles. To test the accuracy of the integration rule on a given function, the convergence between both the exact and computed integrals is measured. The best quadrature rule converges and has minimal error when a modest amount of points are used. After analyzing the errors, one can see which quadrature rule fits the integral the best for radially symmetric two and three-dimensional shapes.

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