Meshless methods have become a research interest due to the simplicity of using scattered data points. The focus of this research involves the use of radial basis function (RBF) collocation meshless method. Radial basis function collocation method or Kansa method is a class of meshless method and can be used in solving partial differential equations. Radial basis functions interpolation capabilities allow for spectral accuracy and exponential convergence. For infinitely smooth radial basis functions such as the Hardy Multiquadric and inverse Multiquadric, the RBF is dependent on a shape parameter that must be chosen properly to obtain accurate approximations. The optimum shape parameter can vary depending on the smoothness of the field. Typically, the shape parameter is usually chosen to be a large value rendering the RBF flat and yielding high condition number interpolation matrix. This strategy works well for smooth data and as shown to produce phenomenal results for problems in heat transfer and incompressible fluid dynamics. The approach of flat RBF or high condition matrices tends to fail for steep gradients and shocks. Instead, a low-value shape parameter rendering the RBF steep and the condition number of the interpolation matrix small should be used in the presence of steep gradients or shocks.

This work demonstrates a method to capture steep gradients and shocks using a blended RBF approach. The method switches between flat and steep RBF interpolation depending on the smoothness of the data. Flat RBF or high condition number RBF interpolation is used for smooth regions maintaining high accuracy. Steep RBF or low condition number RBF interpolation is used for steep gradients providing stability. This method is demonstrated using several numerical experiments such as 1-D advection equation, 2-D advection equation, Burgers' equation, 2-D inviscid compressible Euler equations, and the Navier-Stokes equations.

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Approved for distribution by Alain Kassab, Committee Chair, on September 9, 2018.

The public is welcome to attend.