Solving PDEs with Weighted Moving Finite Elements

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Solving problems containing complex structures or moving shocks using standard methods can be computationally expensive, and using an adaptive mesh to 'track' moving fronts or moving shocks has been shown to provide cheaper and more accurate computations, making them ideal for solving large scale problems.

Recently my work has focused on the development and implementation of a weighted moving finite element method (suggested by K. Miller in 1997). I will present results to several systems of nonlinear PDEs, as well as explain some general ideas behind the moving finite element method and the more recent weighted moving finite element methods. As an example of the results produced by these methods see Figure 1 for solutions of the nonlinear non-dispersive shallow water equations, where (a)-(d) are solutions at different times. This figure shows solutions when at time zero (a) a hump of water is dropped from a center point of a square pool, quickly forming a steep moving front that travels within the domain before it is reflected back from the walls. Figure 2 shows the triangular moving mesh on the first quadrant of the domain, where (a)-(d) correspond to the same solutions as in Figure 1.

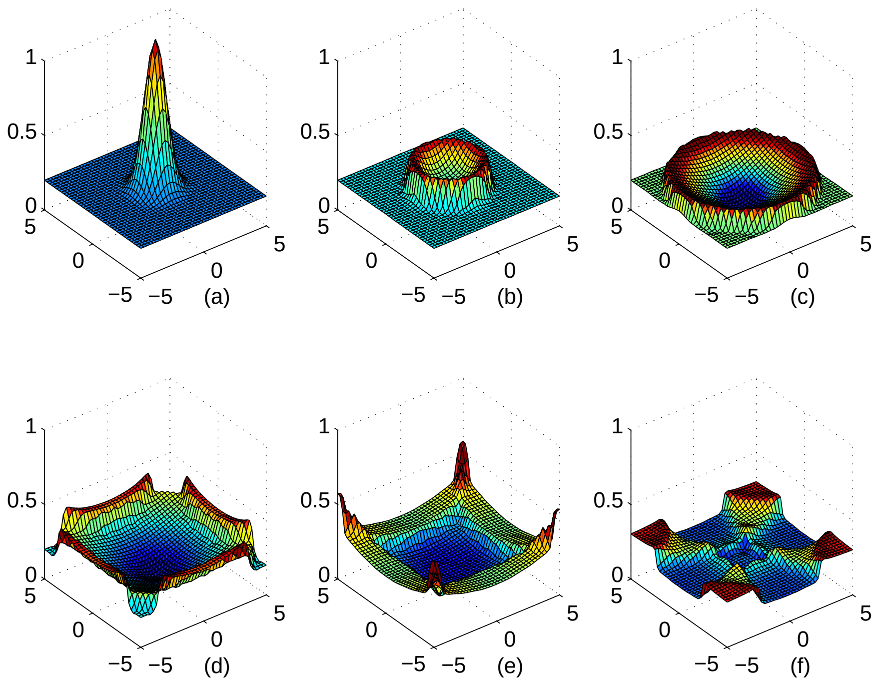

Figure 1: Solutions (of the variable water depth) of the nonlinear shallow water equations produced by the SGWMFE method.

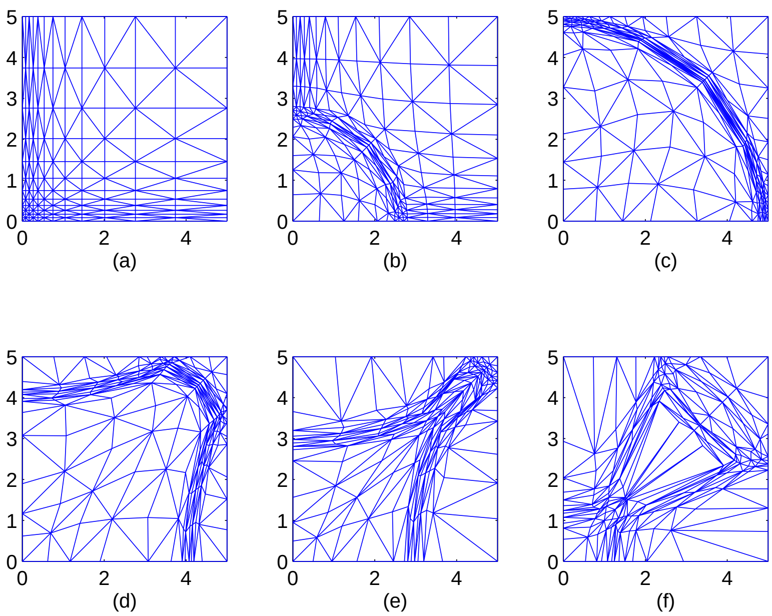

Figure 2: Mesh plots produced by the SGWMFE method corresponding to the solutions of the nonlinear shallow water equations shown in Figure 1.