Abstract. Extrapolation methods for the solution of partial differential equations are commonly based on the existence of error expansions for the approximate solution. Implicit extrapolation, in the contrast, is based on applying extrapolation indirectly, by using it on quantities like the residual. In the context of multigrid methods, a special technique of this type is known as $\tau$-extrapolation. For finite element systems this algorithm can be shown to be equivalent to higher order finite elements. The analysis is local and does not use global expansions, so that the implicit extrapolation technique may be used on unstructured meshes and in cases where the solution fails to be globally smooth. Furthermore, the natural multilevel structure can be used to construct efficient multigrid and multilevel preconditioning techniques. The effectiveness of the method is demonstrated for heat conduction problems and problems from elasticity theory.

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