Some recent results in superconvergence of finite element methods

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In this talk we will present some recent results on the superconvergence of finite element methods. Usually the finite element schemes are not consistent in the finite difference argument. We will give the fact that the consistence of the finite element schemes imply superconvergence. For some special meshes such as Criss-Cross, Union Jack etc, the usual element analysis can not give satisfactory result on the superconvergence but local symmetry theory can give the results on the interior of the domain. Here we use some correction techniques to force the consistency of the finite element schemes and then we obtain the different structures of the finite element solution on different kind of nodes. Hence the superconvergence can be derived via a direct calculation from the error expansions. Some analysis are given for the triangular elements. A new proof for quadratic element is provided and we also have the results for mostly Strong-Regular meshes.