Besov regularity of solutions to the p-Poisson equation

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We are interested in the regularity of solutions to the p-Poisson equation

$$-\mathrm{div}\Big(|\nabla u|^{p-2}\nabla u\Big) = f \qquad \text{in } \Omega,$$

where $1 < p < \infty$ and $\Omega \subset \mathbb{R}^d$ is a Lipschitz domain. We consider the scale $B^\alpha_\tau(L_\tau(\Omega))$ of Besov spaces with $1/\tau = \alpha/d + 1/p$ which arise in connection with adaptive numerical schemes: The Besov regularity of the solution determines the approximation order of adaptive schemes while the convergence rate of non-adaptive (uniform) schemes depends on the Sobolev regularity. We will show that under certain conditions the Besov regularity of solutions to the p-Poisson equation is higher than its Sobolev regularity. The proof of the main result is performed by combining local Hölder regularity results (see [1]) with characterization of Besov spaces by wavelet expansions (see [2]).

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References

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[2] Yves Meyer, *Wavelets and operators*, Cambridge Studies in Advanced Mathematics, Cambridge University Press, 1992.