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Regularity results for solutions to some classes of nonlinear elliptic equations

We deal with the regularity of a solution of the Dirichlet problem associated to the singular equation

$$-\mathrm{div}(a(x)Du) + M\,\frac{|Du|^2}{u^\theta} = f(x) \ \text{ in } \Omega \tag{1}$$

where Ω is an open bounded subset of $\mathbb{R}^N$ $(N \geq 3)$ with smooth boundary, $a(x)$ is a L^∞–matrix satisfying the standard ellipticity condition, $\theta \in]0,1[$, M is a positive constant and f is sufficiently regular i.e. it belongs to a suitable Morrey space.

Namely, we assume that the right-hand side f belong to the Morrey space $L^{m,\lambda}(\Omega)$ with

$$1 \leq m \leq \frac{2N}{2N - \theta(N-2)} \quad \text{and } \ 0 < \lambda < N-2$$

so that our right-hand side doesn't belong to the natural dual space or it is "nearly" a measure $(m = 1)$.

We will be concerned with the regularity of the gradient of a solution in Morrey spaces in correspondence with the Morrey properties of the right–hand side of the equation (1).