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A higher dimensional partial Legendre transform, and regularity of degenerate Monge-Ampére equations

In dimension $n \geq 3$, we define a generalization of the classical two dimensional partial Legendre transform, that reduces interior regularity of the generalized Monge-Ampére equation $\det D^2 u = k(x, u, Du)$ to regularity of a divergence form quasilinear system of special form. This is then used to obtain smoothness of $C^{2,1}$ solutions, having $n-1$ nonvanishing principal curvatures, to certain subelliptic Monge-Ampére equations in dimension $n \geq 3$. A corollary is that if $k \geq 0$ vanishes only at nondegenerate critical points, then a $C^{2,1}$ convex solution u is smooth if and only if the symmetric function of degree $n-1$ of the principal curvatures of u is positive, and moreover, u fails to be $C^{3,1-\frac{n}{2}+\varepsilon}$ when not smooth.