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Qualitative rectifiability results from Usual Square Function Estimates

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In 1993 David and Semmes proved that an Ahlfors-David regular d -dimensional set in $\mathbb{R}^{d+1}$ is uniformly rectifiable if and only if its associated usual square function is bounded on L^2 . We make a step towards more qualitative statements in the plane by replacing the lower bound of the AD-regularity by positive upper density. Concretely, we prove that if the set satisfies a *weak flatness* condition or is a subset of a quasicircle, then usual square function bounds in L^2 imply rectifiability. For the proof of the latter statement we investigate the corresponding *extremal measures* called *Cauchy-flat* measures. This is joint work with Ben Jaye.