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On solution-free sets for systems of quadratic equations

We use a combination of the methods developed by Gowers and refined by Green and Tao in the proof of Szemerédi's theorem on arithmetic progressions in sets and the Hardy-Littlewood circle method to establish an upper bound for the density of a set furnishing no solutions to a system of translation and dilation invariant quadratic equations. In particular, we will consider a system of quadratic equations the solutions to which are triangles similar to a given triangle in $\mathbb{Z}^d$ for $d \geq 7$. We will show that if $\mathcal{A} \subset \mathbb{Z}$ is a set such that $\mathcal{A}^d$ contains no triangles similar to a given triangle in $\mathbb{Z}^d$, then the upper density of $\mathcal{A}$ obeys the bound $\delta_N \ll \exp(-c\sqrt{\log \log N})$ for some constant $c > 0$, a bound independent of the given triangle.