On the existence and avoidance of rational linear patterns

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Let $ax + by = cz + dw$ be a linear equation in the variables (x, y, z, and w) with integer coefficients a, b, c, and d. The equation is said to be translation-invariant if $a + b = c + d$. Its solution is considered nontrivial if x, y, z, and w are distinct. How large can a set be and still manage to avoid all nontrivial solutions of such an equation? Questions of this ilk have been vigorously pursued in the discrete setting (where x, y, z, and w are integers), but depending on the appropriate notion of size, analogous results are relatively fewer in the continuum. We will discuss recent work in this direction with Yiyu Liang.