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On the Quadratic Divisor Problem

Let $d(n) = \sum_{d|n} 1$ denote the divisor function. It counts the number of divisors of an integer. Consider the following shifted convolution sum

$$\sum_{an-m=h} d(n)d(m)f(an,m),$$

where f is a smooth function which is supported on $[x,2x] \times [x,2x]$ and oscillates mildly. In 1993, Duke, Friedlander, and Iwaniec proved that

$$\sum_{an-m=h} d(n)d(m)f(an,m) = \text{Main term}(x) + O(x^{0.75+\epsilon}).$$

Here, we improve the error term in the above formula to $O(x^{0.61})$, and conditionally, under the assumption of the Ramanujan-Petersson conjecture, to $O(x^{0.5+\epsilon})$. We will also present some new results on shifted convolution sums of functions coming from Fourier coefficients of modular forms.