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A Fast Fourier Transform for the Rook Monoid

We define the notion of the Fourier transform for a finite inverse semigroup S and we address the problem of computing it in a time-efficient manner for $S = R_n$, the rook monoid (also known as the symmetric inverse semigroup) on n elements. We do so by exploiting recently developed tools in semigroup theory, and we give an indication as to how these tools generalize to create fast Fourier transforms for arbitrary finite inverse semigroups.