The quantum fractional Fourier transform NGA NGUYEN, New
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Fourier transform (FT) is ubiquitous in signal processing, as it can be used to
filter noise. The digital version, often named the discrete Fourier transform, when
formulated on a basis of quantum states, is the quantum Fourier transform (QFT).
The efficiency in the implementation of the QFT is the main reason for several
quantum speedups, including the one for factoring and the one in phase estimation
at the Heisenberg limit. The fractional FT (frFT) is a generalization of the FT. The
frFT has recently gained attention in signal analysis as it can filter noise in scenarios
where the FT is not useful. Quantum frFTs (QfrFTs), however, have never been
proposed, constructed, or applied. In this work we propose a QfrFT and show that
a good approximation of this transformation can be implemented on a quantum
computer with exponentially less resources than those required for its conventional
implementation. We then analyze some problems in signal analysis for which our
defined QfrFT is useful.

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