# The Parks-McClellan algorithm: a robust and scalable approach for designing digital filters

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Based on the theory of minimax polynomial approximation, the Parks-McClellan algorithm is one of the most well-known approaches for designing finite impulse response filters. In this talk, I will give new insights on the practical behavior of this algorithm.

Barycentric Lagrange interpolation has been the main strength of the Parks-McClellan algorithm since its introduction in the 1970s. More recently it has also been successfully incorporated in the Chebfun library and its implementation of the Remez algorithm for determining best polynomial approximations over closed intervals on the real line. Another important feature of the Chebfun Remez routine is its use of colleague matrix-based rootfinding methods, which have very good numerical behavior in practice.

Together with a new initialization technique, I will show how these well-established ideas can be combined and adapted to the digital filter design setting as well, so as to obtain a very robust and scalable implementation of the Parks-McClellan version of the minimax exchange method. By taking advantage of the fact that, at each iteration of the exchange method, we have some precise information on the distribution of the roots we are looking for, we can use colleague matrix-based rootfinders in a clever way, and write highly parallel and efficient code.

Consequently, the resulting routine outperforms other similar alternatives, found in well-known digital signal processing packages, like Matlab's DSP Toolbox or Scipy.