Preconditioning for non-symmetric Toeplitz matrices with application to time-dependent PDEs

Elle McDonald [1], Jen Pestana [2] and <u>Andy Wathen</u>[3]

[1] *Oxford University, UK mcdonalde@maths.ox.ac.uk*
[2] *Strathclyde University, Scotland jennifer.pestana@strath.ac.uk*
[3] *Oxford University, UK. wathen@maths.ox.ac.uk*

Gil Strang proposed the use of circulant matrices (and the FFT) for preconditioning symmetric Toeplitz (constant-diagonal) matrix systems in 1986 and there is now a well-developed theory which guarantees rapid convergence of the conjugate gradient method for such preconditioned positive definite symmetric systems developed by Raymond Chan, Michael Ng, Fabio Di Benedetto, Stefano Serra Capizzano and Eugene Tyrtyshnikov amongst others.

In this talk we describe our recent approach which provides a preconditioned MINRES method with the same guarantees for real nonsymmetric Toeplitz systems regardless of the non-normality. We demonstrate the utility of these ideas in the context of time-dependent PDEs.