

1106-VO-1910      **Russell L Carden\*** ([russell.l.carden@uky.edu](mailto:russell.l.carden@uky.edu)), 719 Patterson Office Tower, Lexington, KY 40506-0027, and **Josef Sifuentes**. *The Normal Hessenberg completion and Poncelet's Theorem.*

Motivated by the Hessenberg matrices that arise in Krylov based methods such as the Generalized Residual Method (GMRES) for solving linear systems and the restarted Arnoldi method for computing eigenvalues, we consider the Hessenberg normal completion problem: given a non-normal upper Hessenberg  $H \in \mathbb{C}^{n \times n}$  does there exist a normal upper Hessenberg matrix  $H_N \in \mathbb{C}^{(n+k) \times (n+k)}$  such that its leading  $n \times n$  principal sub-matrix is  $H$ . We provide sufficient conditions on  $k$  and the normal difference of  $H$  that ensure a normal upper Hessenberg completion exists. For  $k = 1$ , we show nice connections to and possible generalizations of Poncelet's Theorem. We also explore the implications of our results on the observation of Greenbaum, Ptak and Strakos regarding any possible GMRES convergence curve being achievable by some unitary matrix. (Received September 15, 2014)