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Location analysis of complex trinomial roots with respect to the unit circle in the complex plane

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Stability analysis of linear difference equation with constant coefficients is closely related to a location of roots of its characteristic polynomial, particularly with respect to the unit disk in the complex plane. We focus to a particular case of a trinomial with two strictly complex coefficients

$$T_{k,m}(\lambda) = \lambda^k + \mathrm{i}a\lambda^{k-m} + \mathrm{i}b,$$

where $a, b \in \mathbb{R}$ and $k > m$, $k, m \in \mathbb{N}$. Our aim is to analyze a relation between number of roots of the trinomial $T_{k,m}$ with a modulus lower than one, equal to one and greater than one, and a pair of parameters (a, b). The root locus technique is utilized to obtain regions in the (a, b) plane, where a number of roots of $T_{k,m}$ with modulus lower than one is preserved. Several figures will be introduced to demonstrate the above mentioned regions for particular cases of $T_{k,m}$ together with relevant remarks about their properties. It is also possible to use an introduced procedure in another special cases of polynomials. The talk is based on a joint work with Jiří Jánský.