ABSTRACT

The objective of this research is to develop a generalised scheme to analyse stability for both real and complex polynomials that characterises engineering and biological systems. In general, it deals with the formulation of new algebraic criterion for counting roots in both left and right half of s-plane including those in origin and imaginary axis. Usually, a characteristic equation with real coefficients is the most common form used to represent a system. But, some special class of applications like relative stability analysis of continuous system, analysing transients in power systems, analysing oscillatory behaviours in space applications and analysis of time-delay systems and nonlinear systems involves complex polynomials. The proposed new criterion is capable to infer roots in both real and complex polynomials at the same pace and accuracy. It uses a stability table and involves very few computations. For continuous system, the analysis is made along the imaginary axis of s-plane and for discrete system; it is done along the unit circle of z-plane.

The prime function of the criterion is to reveal whether a system is stable or unstable. Using the criterion, simple procedures have been evolved to cater all forms of stability needs like absolute stability, marginal stability, aperiodic stability, relative stability and dynamic stability analysis. For analysis and design of aperiodic stability in continuous systems, a generalised approach involving new criterion with fuller's scheme is adopted. All such stability analysis can be easily extended to discrete systems using bi-linear transformation.

Based on the criterion a novel scheme has been developed to analyse stability in time-delay systems usually found in process control applications and biological systems.

Using the proposed criterion, new algorithms have been developed to analyse stability in non-linear systems frequently found in most of the real engineering applications.

Using the new Criterion, simple design algorithms have been proposed to achieve aperiodic response in output feedback controller designs and state variable feedback controller designs. It is very much useful in some critical applications where no overshot is permitted. It reduces the repeated simulations and design time.

Suitable examples are provided to exemplify the proposed schemes using the new criterion.