

Control Bifurcations

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Abstract

A classical bifurcation of a parameterized dynamical system typically occurs at an equilibrium where one or more eigenvalues of the linear part of the dynamics lie on the stability boundary. For continuous time systems the stability boundary is the imaginary axis and for discrete time systems it is unit circle. When there are eigenvalues on the stability boundary the linear part of the dynamics does not determine the local stability or instability of the equilibrium. In low codimensions there are only a few ways a classical bifurcation can happen and these are classified by center manifold theorem and the normal form of the center manifold dynamics.

A control system typically has a continuum of equilibria corresponding to different set values of the control. If the linear part of the control system at an equilibrium is stabilizable then the nonlinear system is locally stabilizable to the equilibrium. A control bifurcation occurs at an equilibrium where the linear part is not stabilizable. Again in low codimensions there are only a few ways a control bifurcation can happen and these are classified by the theory of normal forms. The equilibrium is locally stabilizable if there exists a feedback that stabilizes the center manifold dynamics.