A Diffeomorphic Positive Polynomial Map and its Implications in Chemistry

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Presentation Abstract

We present a multivariate polynomial map with nonnegative coefficients that is diffeomorphic on the nonnegative orthant. We begin with a general discussion of global injectivity, and in particular of the Global Univalence Theorem of Gale and Nikaidô, which we apply to the map of interest. We then introduce the class of complete networks of reversible binding reactions. This class includes many biochemical reaction systems that are studied in pharmacology for understanding the interactions of various molecules, e.g. cell-surface or circulating receptors and pathogenic or therapeutic ligands. It turns out that the polynomial equation resulting from the map of interest characterizes the equilibrium states for complete networks. As a result, the equilibrium state for a complete network exists and is unique with respect to the biochemistry-sensible notion of total concentrations of elementary species.