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Classical quasi-steady state reduction – A mathematical characterization

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Abstract

We discuss parameter dependent polynomial ordinary differential equations that model chemical reaction networks. By *classical quasi-steady state (QSS) reduction* we understand the following familiar (heuristically motivated) mathematical procedure: Set the rate of change for certain (a priori chosen) variables equal to zero and use the resulting algebraic equations to obtain a system of smaller dimension for the remaining variables. This procedure will generally be valid only for certain parameter ranges. We start by showing that the reduction is accurate if and only if the corresponding parameter is what we call a QSS parameter value, and that the reduction is approximately accurate if and only if the corresponding parameter is close to a QSS parameter value. The QSS parameter values can be characterized by polynomial equations and inequations, hence parameter ranges for which QSS reduction is valid are accessible in an algorithmic manner. A defining characteristic of a QSS parameter value is that the algebraic variety

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