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Multiscale Set-Oriented Computations for Dynamical Systems

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Abstract: Dynamical systems theory provides a useful framework for understanding phenomena in which the state changes dynamically as time passes. In particular, Conley's fundamental theorem of dynamical systems tells us that any dynamical system can be decomposed into recurrent components and gradient components which connect between the recurrent components. This allows us to describe a dynamical system by a finite directed graph. Although it is difficult to obtain such a decomposition for a concrete example by hand, recent developments of computers and numerical methods have enabled us to obtain it by utilizing a computer. The finite graph description of a dynamical system associated with the Conley indices, which represents the topology and stability of the corresponding recurrent component, is called the Conley-Morse graph. We briefly introduce a numerical method for computing the Conley-Morse graph for a given dynamical system, and we would like to share some difficulties to overcome.

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