Critical transitions for asymptotically concave ordinary differential equations

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The occurrence of tracking or tipping situations for a transition equation $x' = f(t, x, \Gamma(t, x))$ is analyzed under the assumption on concavity in x of the maps giving rise to the asymptotic equations $x' = f(t, x, \Gamma_{\pm}(t, x))$, but without assuming this condition on the transition equation itself. The approaching condition is just $\lim_{t\to\pm\infty}(\Gamma(t, x) - \Gamma_{\pm}(t, x)) = 0$ uniformly on compact real sets, and so there is no restriction to the dependence on time of the limit equations. The analysis provides a powerful tool to analyze the occurrence of critical transitions for one-parametric families $x' = f(t, x, \Gamma^c_{\pm}(t, x))$. The new approach significatively widens the field of application of the results, since the evolution law of the transition equation can be essentially different from those of the limit equations. As an application, a scalar population dynamics model subject to non trivial predation and migration terms is analyzed.

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