HIROSHIMA MATH. J.
19 (1989), 587–630

Singular perturbation approach to stability properties of traveling wave solutions of reaction-diffusion systems

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(Received January 18, 1989)

1. Introduction

A variety of propagating phenomena for reaction-diffusion systems have been investigated in physics, chemistry, biology and other fields. Among these phenomena, there are traveling waves in bistable reaction media which correspond to propagating transition from one stable state to the other. See e.g. Ortoleva et al [29], [30], Fife[8], [9] and their references therein. These waves are basically modeled by a two-component system of the form

$$\begin{cases} \varepsilon\tau u_t = \varepsilon^2 u_{xx} + f(u, v) \\ v_t = v_{xx} + g(u, v) \end{cases} \tag{1.1}$$

with the nonlinearities of f and g in Fig. 1. It is shown that there are three spatially constant steady states $(E_{\pm}, E_0)$: two of them $(E_{\pm})$ are stable, while one (E_0) is unstable. One simple but very substantial nonlinearities of f and g is the Bonhoeffer-Van der Pol kinetics

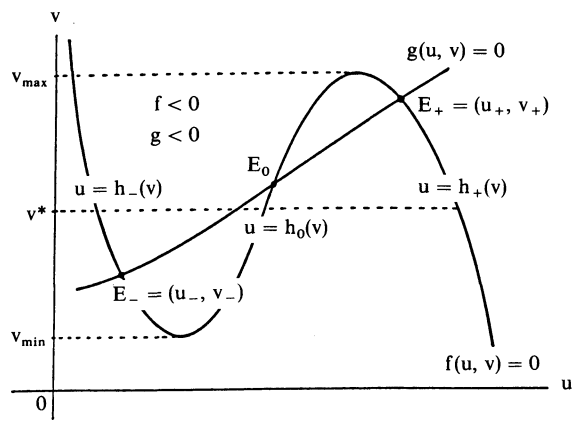

Fig. 1: Functional forms of $f = 0$ and $g = 0$ in (1.1).

This research was partially supported by the Grant-in-Aid for Scientific Research (No. 63540156), Ministry of Education, Science and Culture.