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PREFACE

This special volume of Methods and Applications of Analysis contains the contributions from speakers as well as participants of the workshop "IMS Workshop on Reaction-Diffusion Systems" held at IMS, Chinese University of Hong Kong from December 5th, 1999 to - 11th, 1999.

The purpose of this workshop is to study reaction-diffusion equations and related systems with particular emphasis on problems with solutions that exhibit transition phenomena. There are two main types of transition phenomena depending on the nature of the nonlinearity; spike-type behavior and transition layer behavior. Spike-type solutions occur when the solution concentrates at certain isolated points in the domain. This behavior is known as point-condensation phenomena, and it occurs in most models of biological morphogenesis, in chemotactic response in biology, in hot-spot formation in microwave heating of ceramic materials, and in pulse-replication phenomena in chemical reaction models, including the Gray-Scott model. Transition layer behavior occurs when the solution exhibits a rapid variation across a smooth surface in the domain. Such solutions are very common in the broad field of materials science including, the motion of grain boundaries and junctions, the coarsening behavior for continuum models of phase transition, and the microphase separation of di-block copolymers. Phase transitions have also been observed in chemotaxis models.

All of these localization phenomena have been observed in experimental situations. In recent years, there has been considerable progress in both the modeling and the mathematical analysis of localization behavior. A common feature of these patterns are that different spatial scales are involved. For spike patterns there is a homogeneous distribution, which is perturbed in small regions by spikes. Transition layers show thin regions of transition from one equilibrium state to another.

Our aim is to bring together active researchers working in these fields, especially, understanding of formation as well as dynamics of *interfaces* and *spikes* arising in reaction-diffusion systems, from analytical and application viewpoints, and give comprehensive presentations of the basic idea and more advanced developments and thus to encourage exchanges between mathematics and phenomena, in the hope of opening new directions for research and leading to the development and application of improved analytical tools for studying these problems.

The list of participants includes both senior researchers and junior faculty who have made outstanding contributions. This volume contains most of the talks given in the workshop and the contributions by the participants.

I would like to take this opportunity to thank Professor S.-T. Yau and Professor Z.-P. Xin, whose support is crucial in the success of this workshop, Professor M. Mimura, who co-organized this workshop, and all the speakers and participants, who made this workshop successful. Last but not the least, I would like to thank Miss Lily Chan for her dedication and help during the workshop, and Jenny Chen for the typing and editing.

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