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# Marine Physical Laboratory

## Topics in Pattern Formation and Chaotic Systems

H. D. I. Abarbanel

Final Report to the
Office of Naval Research
Contract N00014-89-D-0142 (DO#23)
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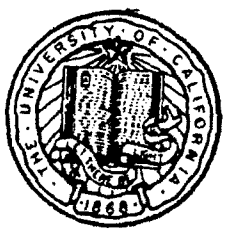


University of California, San Diego
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# Topics in Pattern Formation and Chaotic Dynamics

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## *Abstract*

This project was a Joint Research Project in the study of Pattern Formation and Chaotic Dynamics by members of the Institute for Applied Physics (IPFAN) in Gorky, USSR and the Marine Physical Laboratory, at the University of California, San Diego, USA. This project involved both experimental and theoretical research in the topic of interest.

## *Objectives and Benefits of the Research*

At both IPFAN and UCSD the scientists named have investigated the creation of patterns in spatio-temporal systems and the chaotic dynamics of these systems in several specific examples:

- Dynamics of Surface Waves. Variations on the classical Faraday Experiment
- Surface tension induced convection. Benard-Marangoni Convection
- Vortex generation in the wakes of bluff bodies
- Boundary Layer Chaos and Transition in Turbulence

Our goals, enlarged upon below, combined the experience and expertise developed in the study of coherent phenomena and the characterization

of the chaotic dynamics of phenomena in these fluid flows. The benefits of creating cooperative efforts of these groups comes in several ways:

- the Soviet group had explored many more flow situations than the US side because of their larger complement of participating scientists and their longer working period in the field. The US side had both extensive experience in the flow situations it had analyzed and had developed many new and innovative ways to instrument and analyze the data from these experiments. The combination of these qualities illuminated the research on both sides in a clear fashion.
- the analysis of the data from these experiments was carried out in a quite different fashion on the US side since there existed more extensive computer power for simply asking a larger variety of questions on the US side.
- the US side had developed several information theoretic techniques for analyzing data from experiments of this variety. Extending their analysis to many of the more complex situations already started in the USSR enabled the refinement of the US methods for use in oceanographic and meteorological data.
- The US side had extensive contacts (and joint appointments) within the US meteorological and oceanographic communities and this enhanced the pursuit of both sides in the application of their methods to geophysical field problems--of interest to members of both groups.

## *Research Summary*

The Principal Investigators for this effort were M.I. Rabinovich in Gorky and H.D.I. Abarbanel in San Diego. The senior scientific personnel who participated on the USSR side were A.V. Gaponov-Grekhov, I.S. Aronson, A. Zobnin, A. Ezersky, V. Afraimovich, V. Reutov, M. Suschik, L. Tsimring, and Y. Stepanyantz. On the US side the senior participants were H. Abarbanel and E. A. Novikov.

To provide strong mutual contact between the groups, one postdoctoral level person (post Candidate in the USSR) from each location worked at the cooperative site. A Gorky researcher came to UCSD for one year, and a UCSD researcher went to Gorky for 3 months. In addition, we had a one month long visit from two senior researchers from Gorky to UCSD. On each occasion scientific lectures were delivered and scientific research in spatio-temporal chaos was performed. This helped keep each side informed of the new developments, both theoretical and experimental in the joint program and assured the widest dissemination of the ongoing research progress.

This project was sponsored by another agency which sent the funds through ONR. A full reporting to that agency has been completed.

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