lyzer and function generator. The goals are learning the basic controls of the spectrum analyzer and function generator, making measurements showing SigLab's excellent dynamic range and spectral purity and extracting the just acquired data and post-process in MATLAB. I got the feeling that Prof. Jiang and his research group are very much interested in these topics as well as and that our cooperation will be continued.

Summary

I would like to express my deep thanks to Professor Zhongwei Jiang and his family for inviting me and the service they rendered me from the first day of my arrival up to my departure. I am also thankful to Dr. Seiji Shimizu and the students of Prof. Jiang's laboratory for the interest to the subject of my research and their help in carrying out our experiments. I am grateful to the President of Yamaguchi University and the Dean of the Faculty of Engineering and the Director of Venture Business Laboratory for accepting me as a visiting associate professor. This was a great chance for me to learn more about Japanese education and research. I enjoyed my stay and work at Yamaguchi University enormously. I hope the joint collaboration will continue in the future.

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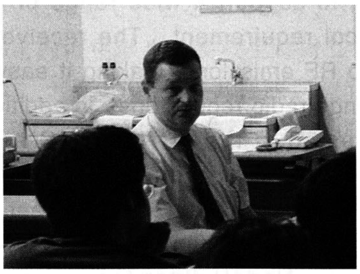


世話教官：工学部・機械工学科教授　西村龍夫

Introduction

Continuity is one of the conditions in the successful pursuit to solving challenging problems, and Professor Tatsuo Nishimura's kind invitation provided for the support. The time spent during the visit to working and discussing both research and educational problems is invaluable to the success of our efforts in finding solutions to joint projects and also to the initiation of new research themes.

The background of our cooperation goes back to the period of 1995-1996 when - on Professor Nishimura's recommendation - I was accepted and acted as associate professor with the Department of Mechanical Engineering, Energy Division at Yamaguchi University in Ube. A further important stage of our joint research was the research grants conducted within the framework created by the bilateral governmental agreement Japan-Romania (1998-2000). Our collaboration continued through out this period and it is substantiated by the numerous papers published in peer refereed journals and proceedings to international conferences. This body of work reflects the progress in the areas of heat and mass enhancement in channel flows and double-diffusive convection - one of the most challenging problems in many areas such as material sciences, ocean sciences, magnetohydrodynamics, etc. - that continue to focus the attention of the scientific community.

Research

The visit helped greatly to extend the investigations in the area of double diffusive convection, initiated and conducted by Professor Tatsuo NISHIMURA at Yamaguchi University. Double-diffusive convection plays an important role in electronic material processing such as crystal growth, solidification, laser melting, etc. and its knowledge and control are important in obtaining high quality materials. This class of phenomena poses strong nonlinear, coupled physical and mathematical problems, which are characterized by abrupt changes in the temperature and concentration fields. Its study is challenging in many ways for experimental models, and particularly difficult to integrate numerically. Our approach to this problem was both experimental and numerical - to this end we developed a high resolution, pseudospectral (collocation) Chebyshev solver.

When the working fluid (e.g. molten material) has electroconductive, electric or magnetic properties, an electromagnetic field may help control the flow, hence the transport properties of the system. Although a vast body of literature is devoted to magnetic field control on thermally induced convective flows in electroconductive fluids, little attention was given to double diffusive convection flows (heat and mass system) under magnetic field influence (magnitude and orientation). This motivates our study, and our current numerical results were reported at the Yamaguchi University Venture Business Laboratory in August. This work is continued.

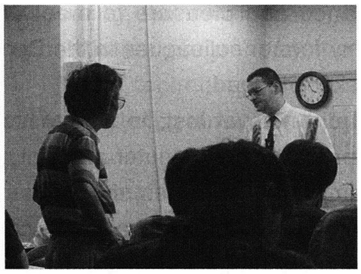
Future work

An interesting research topic that we decided to further investigate is heat and mass double-diffusive convection of low-Prandtl fluids, with a focus on transport properties and on the intrinsic nonlinear dynamics effects - an extension to our previous work on salty stratified systems.

Enhancement of heat and mass transfer under laminar, stationary and pulsating flow conditions is a mater of great interest in many areas such as biomedical and biochemical engineering, and Professor Nishimura and his co-workers are one of the leading groups. The knowledge of the properties of these flows is needed for the evaluation of heat and mass transfer in the inertial and unsteady regions. Numerous experimental and numerical works are devoted to the investigation of wavy-walled channels and tubes utilized in physiological and biomedical applications, flows in furrowed membrane artificial lung and flows in arterial prostheses. Periodically constricted tubes are used also to investigate the flow of blood in vessels and its impact in occlusive vascular diseases. The computed flow fields can also be relevant in the study of transport of Oxygen and stenoses, causing lipid particles. In particular, it is speculated that the trapping of these impurities in the separation region precedes the formation of a plaque of atheroma.

Our current numerical and experimental work in this area is focused on channel and tube flows mass and heat transfer enhancement, with emphasis on flow instabilities. We are currently developing 2D (axial symmetric) and full 3D finite element models - the expected numerical results are to accurately complement Professor Nishimura's experimental studies.

The third, but not the least important research topic that we decided to consider in the near future is the magnetic field control on heat and mass transport processes in paramagnetic plasma gases. Here again, we are using finite element models.



It is important to note that one particular feature of our numerical work is that it addresses inter- or multidisciplinary problems, of "multiphysics". It is a challenging task and its successful approach requests expertise in several fields - fluid dynamics, heat and mass transfer, chemistry, electromagnetism, numerical analysis and methods, nonlinear dynamics - such as our group has.

An important event during the visit was the Heat Transfer Conference in Okayama. On this occasion I had the chance to hear and talk with experts and professionals, and the first-hand information on the current research results and priorities acquired on this occasion is invaluable.

Finally, but surely not the least, there are the great opportunity and privilege that were offered me again to visit and feel the sense of the beautiful, ever appealing Japan.

Closure

First of all, I wold like to express my highest appreciation and gratitude to Prof. Tatsuo Nishimura who made possible this visit. I could feel in many senses his very friendly and supportive attitude. It is with renewed motivation and commitment that we will continue our joint research work. The few weeks spent in Yamaguchi are of reference for the joint research projects that we are conducting under Prof. T. Nishimura's leadership. On a broader scale, this visit contributes to strengthening the cooperation between Politehnica University of Bucharest and Yamaguchi University.

I am grateful to Dr. H. Hironaka, the President of Yamaguchi University and Dr. H. Miike, the Director of the Venture Business Laboratory for the opportunity to work and strengthen the cooperation with Prof. T. Nishimura's team, under the patronage of VBL. Also, I would like to thank Prof. Hideo Osaka, the Dean, for kindly remembering my previous stay in Ube and for talking with me on current research interests.

The chance and pleasure to meet and talk with many of my former colleagues in the Department are warmly acknowledged.

And if I did not get lost, in all senses (language, data postprocessing, computer account, traffic, train, buses, administrative issues, etc.), it is because Mr. Kouji Kunitsugu helped me a lot to carry on - my warmest thanks and friendly greetings for the time and efforts spent with me.

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Landau theory on the structural phase transitions in ferroelectric materials

Phenomenological theory of phase transitions (the Landau theory) successfully explained many different kinds of structural phase transitions, e.g., proper and improper ferroelectric ones, phase transitions through the incommensurate phase of two types, complicated sequences of phase transitions including the incommensurate phase (the Devil's staircase).

We apply a phenomenological approach in order to explain the temperature-pressure, T-P, phase diagrams of the crystals from the rich family of $\{N(CH_3)_4\}_2MX_4$ compounds (TMAX-M, where X is halogen and M is divalent metal, respectively). These crystals were investigated experimentally by Japanese scientists (see, e.g. the review by Gesi: Ferroelectrics **66** (1986) 269). We suppose that all phases observed in experiment are determined by the single soft branch of the vibration spectrum of the crystals. We suppose also that this branch has two minima in some range of parameters. Due to this a triple point of the new type exists on the T-P phase diagram of TMA-family crystals (this point was predicted theoretically by Aslanyan and Levanyuk: Fiz. Tverd. Tela (Leningrad) **20** (1978) 804). We use two different phenomenological descriptions of incommensurate phase transitions to obtain thermodynamic potentials for all phases observed on the experimental T-P phase diagram. Equating these potentials to each other, we obtain expressions for boundaries between different phases. We plot the phase diagram on the plane of the two small coefficients of the potentials which dependences on T and P can be essential. Assuming that these coefficients depend linearly on T and P, we then plot the theoretical T-P phase diagram. So deriving we obtain the T-P diagram for the TMAB-Zn crystal in sufficiently good agreement with the experimental T-P diagrams (paper 1).

The T-P phase diagram for the TMAI-Zn obtained experimentally by Gesi (J. Phys. Soc. Jpn. **58** (1989) 1532) has specific features. There is no incommensurate phase on it, and there is a triple point between the initial C phase (of the symmetry group D_{2h}^{16}), and the commensurate phases, C_0, with q=0 and $C_{1/2}$ with q=1/2 (q is a dimensionless wavevector). This point of such kind is met at the first time. We suppose that these features can be explained if the C-$C^{1/2}$ phase transition is of first order. We calculated and plot the theoretical T-P diagram for this crystal and obtain a fairly well agreement with the experimental T-P diagram (paper 2).

In the well-known paper by Iizumi et al. (Phys. Rev. **B15** (1977) 4392), the experimental dependence of acoustic branch of vibration spectrum of K_2SeO_4 on wavevector is presented.

At different temperatures T near the temperature $T=T_c$ of the phase transition into the incommensurate phase, we apply a phenomenological approach to calculate this dispersion. We use the simple thermodynamic potential including two variables, which interact via the Lifshitz-type invariant. Taking the values of some coefficients from experiment and giving to some other coefficients definite values we calculate and plot the dispersion of the acoustic branch, which is a comparatively good agreement with experiment (paper 3).

During the stay in Yamaguchi University, above three papers have been completed. The author is grateful to VBL for the financial support.