

# Sabbatical Leave Report for Academic Year 2005-6

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## Summary:

I spent the sabbatical leave from August 2005 to June 2006 at the Department of Chemical Engineering, Korea University, Seoul, South Korea. I had achieved most of the proposed objectives outlined in my proposal for sabbatical leave. The leave was very productive in both intellectual and relational aspects. The experience has a direct impact on my faculty development, both in teaching and research.

## Objective 1: Teaching graduate courses at Korea University

I taught two semesters of applied math courses in the chemical engineering department at Korea University, during the fall '05 semester and the spring '06 semester. The initial plan was to teach the same course I had taught before in the chemical engineering department at Michigan Tech. However, the course needed to be modified significantly to accommodate the English skills of the class while adding special topics of particular interests to the students and the department.

Specifically, I developed new course materials to include finite element methods to the syllabus. Usually, a separate-long semester course is devoted to finite element methods. I had to relearn the material, research new developments and encapsulate the topics to fit the course. In addition, because the students were not familiar with the required software for the class, I had to give some special tutorials on Matlab.

## Objective 2: Textbook writing

I finished the text portion of the textbook: Methods of Applied Mathematics. The original planned size of volume has at least doubled from approximately 400 pages to 800 pages. Some major enhancements and additions were included as follows:

- a) a chapter on finite element methods was added, including grid generation techniques
- b) a chapter on finite difference methods was added, including solution of high-dimensional systems and hyperbolic systems
- c) sections on solution of stiff ordinary differential equations and stability analysis were added.
- d) sections on conjugate gradient methods and iterative methods were added.

- e) sections on QR methods for evaluating eigenvalues were added.
- f) sections on general curvilinear orthogonal coordinates were added
- g) Matlab codes are now included in the textbook throughout the chapters
- h) Problem sets have been written for 50% of the chapters.

Unfortunately, due to the substantial enhancements done for volume 1, proposed advancements in volume 2 had not been achieved as planned.

### **Additional Activities:**

Paper submitted:

Sridhar Ungarala, Kalyani Miriyala and Tomas B. Co, "Parameter Estimation Using Finite Fourier Series And Modulation", submitted to Automatica for publication.

Forum and conferences attended:

UNESCO international forum on the reform and innovation in science and engineering higher education in the Asia-Pacific region organized by the Korea Science Foundation, Korean National Commission for UNESCO and UNESCO, 12-14 September 2005, Seoul, Korea. Tower Hotel, Seoul, South Korea

7<sup>th</sup> International Symposium on Applied Rheology, May 25, 2006, Korea University, Seoul, South Korea

Software development:

**RK4**, version 3.0. A Microsoft Excel Add-In to be used for simulating dynamic models using the Runge-Kutta method. Special enhancements allow for direct parameter estimation using least squares method.

### **Conclusion:**

I had achieved a major portion of the activities that were proposed for the sabbatical leave. The experience was very productive and very enjoyable. Outside of the technical issues, another important advantage of the sabbatical leave is the establishment of very good relationships with the faculty at Korea University. I think we can further build on this relationship to enhance the international links between Michigan Tech and other universities such as Korea University.