



SOUTH EAST ASIAN MATHEMATICAL SOCIETY

FINAL REPORT

Partial differential equations for image processing: theory and numerics

Nakhon Pathom, Thailand

January 3 – 12, 2018

Organized by

Department of Mathematics, Silpakorn University, Thailand

with the support of

Centre International de Mathématiques Pures et Appliquées

South East Asian Mathematical Society

International Mathematical Union

Center for Promotion of Mathematical Research in Thailand

Silpakorn University

University of Picardie Jules Verne, LAMFA CNRS, France

University of Évora, Portugal

University Aberta, Portugal

Centre of Mathematical Analysis, Geometry and Dynamical Systems, IST Portugal

2018

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I. Summary

In this school, we introduced some basis of the theoretical and numerical mathematical analysis to study partial differential equations arising in image processing. Theoretical lectures were complemented by practical sessions through scientific Python software.

A website and a chat group were created to facilitate exchanges between students, lecturers and organizers. A drive, accessible directly from the website of the school, contains the lectures, the python script and the list of exercises.

Website

<https://sites.google.com/site/seamsthailand2018>

Drive

<https://sites.google.com/site/seamsthailand2018/documents>

II. Scientific Objectives and Rationale for the School

The area of numerical analysis in Thailand is well developed on the fixed point theory and optimization. Applications of numerical techniques to handle real world problems can be scarcely found. The Department of Mathematics at the Silpakorn University aims to create a young researchers group from ASEAN community to work on both the numerical analysis and its applications, especially the numerical methods in image processing.

This school was the first active SEAMS school concerning numerical analysis and scientific computing of partial differential equations in Thailand. It testifies the ability of the Silpakorn Dept. of Mathematics to participate in South East Asia (ASEAN) cooperation.

After the school, the Silpakorn University joins the European-Asian network launched by Prof. Joaquim Correia through the Erasmus+ call (enrolling by now, in Asia, Laos, Thailand, Vietnam, Philippines and India, in Europe, Scotland, France and Portugal).

III. Organizers and Lecturers

Scientific coordinators:

1. Name	:	Mrs Pornsarp Pornsawad
Institution	:	Silpakorn University, Nakhon Pathom, Thailand
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2. Name	:	Mr Youcef Mammeri
Institution	:	University of Picardie, Amiens, France
Email and Phone	:	youcef.mammeri@u-picardie.fr +33-3-22827605
3. Name	:	Mr. Joaquim Correia
Institution	:	University of Évora, Évora, Portugal
Email and Phone	:	jmcorreia@uevora.pt +351-91-7806756

Local organizers:

The department of mathematics of Silpakorn university hosts the school. Local staff and students were involved to make this event a great success.

Mr. Worakrit Supaporn, PhD
Mrs. Wannapa Panitsupakamon, Assistant Professor
Miss Sawanya Sakuntasathien, PhD
Mr. Supap Kirtsaeng, PhD
Mr. Jittisak Rakbud, PhD
Miss Nairat Kanyamee, PhD
Miss Tiwadee Musunthia, PhD, Assistant Professor
Miss Tammatada Khemaratchatakumthon, PhD
Mr. Sittisede Polwiang, PhD
Miss Passawan Noppakaew, PhD
Miss Sineenuch Suwannaphichat, PhD
Mrs. Parichat Srathongshoum, Staff
Mrs. Gingdao Sarajoum, Staff

Miss Parada Sungcharoen, Master Student
Mr. Naeem Binibroheng, Master Student
Mr. Kitipong Thangsi, Master Student
Mr. Kittipong Subwattanachai, Undergraduate Student
Miss Phitchapha Lertsiravarameth, Undergraduate Student
Miss Rangsimai Traiwet, Undergraduate Student
Miss Charatphon Phatchoun, Undergraduate Student
Miss Thongkorn Raksantinana, Undergraduate Student
Miss Sitranoot Pummiprakai, Undergraduate Student
Miss Arunya Klaypothong, Undergraduate Student
Miss Monthicha Noibanlat, Undergraduate Student
Miss Pornpimon Sroisangwan, Master Student
Miss Chanapat Suttipan, Master Student
Miss Pitchaporn Paitong, Master Student

Lecturers:

Five international lecturers, accompanied by a doctor from the host University (who is a PhD from UK), ensured the lessons. Two assistants from Silpakorn University and two assistants from the National University of Laos were giving a hand up. We had the opportunity to loop Professor Fernando da Costa from University Aberta (Portugal). He is a world recognized researcher and valuable teacher. We decide to share the lecture of Prof. Nabil Bedjaoui and it was really appreciated by the students.

1. Mr Noppadol CHUMCHOB, PhD, Silpakorn University, Thailand
Assistant professor

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2. Ms Marília PIRES, PhD, University of Évora, Portugal
Assistant professor

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3. Mr Joaquim CORREIA, PhD, University of Évora, Portugal
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4. Mr. Fernando Pestana da COSTA, PhD with Agregação, University Aberta, Portugal

Associate professor
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5. Mr Nabil BEDJAOUI, PhD, University of Picardie, Amiens, France
Maître de conférences

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6. Mr Youcef MAMMERI, PhD, HDR, University of Picardie, Amiens, France
Maître de conférences HDR

<http://www.lamfa.u-picardie.fr/mammeri>
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IV. The Participants

50 participants were present during this SEAMS school, among them 24 non-Thai (coming from India, Indonesia, Myanmar, Philippines, Vietnam, Laos and Cambodia) and 26 Thai. We note that 24 are females and 26 males.

Name	Address	Gender
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Foreign participants

1	Surojit Biswas	<i>IIT Kharagpur, India</i>	M
2	Saheb Dalapati	<i>IIT Bhubaneswar, India</i>	M
3	Anggia	<i>Institut Teknologi Bandung, Indonesia</i>	F
4	Vanessa Sutandar	<i>Institut Teknologi Bandung, Indonesia</i>	F
5	Saw Win	<i>University of Mandalay, Myanmar</i>	M
6	Airish Pelemeniano	<i>Caraga State University, Philippines</i>	F
7	Cheryl Quindao-Mentuda	<i>Caraga State University, Philippines</i>	F
8	Tran Dinh Phung	<i>Quy Nhon University, Vietnam</i>	M
9	Bouasy Doungsavanh	<i>National University of Laos</i>	F
10	Bounmy Khaminsou	<i>National University of Laos</i>	M
11	Gnord Maypaokha	<i>National University of Laos</i>	F
12	Kedtysack Xayxanadasy	<i>National University of Laos</i>	M
13	Khankham Vongsavang	<i>National University of Laos</i>	M
14	Lisatteur Lilianou	<i>National University of Laos</i>	M
15	Phoui Souksomvang	<i>National University of Laos</i>	M
16	Latsamy Phonesay	<i>Savannakhet University, Laos</i>	M
17	Saysamone Saiyasand	<i>Savannakhet University, Laos</i>	M
18	Sirixay Somphonephachan	<i>Savannakhet University, Laos</i>	M
19	Somsanith Sithtisak	<i>Savannakhet University, Laos</i>	M
20	Thongma Keomanivong	<i>Savannakhet University, Laos</i>	M
21	Mettachit Sengsouly	<i>Savannakhet University, Laos</i>	F
22	Thotsakanh Sithivong	<i>Savannakhet University, Laos</i>	M
23	Somavatey Meas	<i>Prince of Songkla University, Hat Yai Cambodian student</i>	F
24	Chreanvutha Im	<i>Mahasarakham University Cambodian student</i>	M

Local participants

25	Pisamai Kittipoom	<i>Prince of Songkla University, Hat Yai</i>	F
26	Athassawat Kammanee	<i>Prince of Songkla University, Hat Yai</i>	M
27	Worachat Imlek	<i>Burapha University, Chonburi</i>	M
28	Siriwan Chankan	<i>Kanchanaburi Rajabhat University, Kanchanaburi</i>	F
29	Tharana Yosprakob	<i>Chulalongkorn University, Bangkok</i>	F
30	Dussadee Somjaiwang	<i>King Mongkut's University of Technology Thonburi, Bangkok</i>	F
31	Yotsawat Terapabkajornded	<i>Mahidol University, Bangkok</i>	M
32	Somsak Orankitjaroen	<i>Mahidol University, Bangkok</i>	M
33	Chatchawan Watchararuangwit	<i>King Mongkut's University of Technology Thonburi,</i>	M
34	Kanya Maleelai	<i>King Mongkut's University of Technology Thonburi,</i>	F

35	Sopida Jewprasert	<i>Phranakhon Si Ayutthaya Rajabhat University, Ayutthaya</i>	F
36	Sunee Pongpinigpinyo	<i>Silpakorn University</i>	F
37	Pornchanok Kummaung	<i>Silpakorn University</i>	F
38	Tereporn Thongsiri	<i>Silpakorn University</i>	M
39	Piyawat Wongthongone	<i>Silpakorn University</i>	M
40	Pitchaporn Paitong	<i>Silpakorn University</i>	F
41	Pakkapon Phongthawee	<i>Silpakorn University</i>	M
42	Risa Masiri	<i>Silpakorn University</i>	F
43	Nichanat Wiriyakaset	<i>Silpakorn University</i>	F
44	Sawanya Sakuntasathien	<i>Silpakorn University</i>	F
45	Naeem Binibroheng	<i>Silpakorn University</i>	M
46	Satanan Thipworawimon	<i>Silpakorn University</i>	F
47	Wannapa Panitsupakamon	<i>Silpakorn University</i>	F
48	Nairat Kanyamee	<i>Silpakorn University</i>	F
49	Kanyakorn Cheuprasert	<i>Silpakorn University</i>	F
50	Prarinya Morrakutjinda	<i>Silpakorn University</i>	M

V. School Programs

1. Scientific python

Marília Pires, PhD, University of Évora, Portugal

This practice presents the main features of a free software to solve mathematical equations derived from concrete problems. This course is done on computer.

- Presentation of python
- Basics (number, characters, function), Graphics
- Linear and nonlinear systems
- Numpy, Sympy.

2. Finite difference methods for PDEs

Noppadol Chumchob, PhD, Silpakorn University, Thailand

- Brief overview of ordinary and partial differential equations
- Elliptic PDE: 1D, 2D elliptic problems, Convergence theory
- Parabolic PDE: 1D heat equation, Stability, Convergence theory for time-dependent problems
- Image processing-image restoration.

3. Exact solutions of smoothing PDEs

Nabil Bedjaoui, PhD, University of Picardie, France

- Separation of variables, Fourier series
- Fourier transform

Fernando da Costa, PhD, University Aberta, Portugal

- Convolution
- Image restoration, Filtering.

4. Hyperbolic PDEs

Nabil Bedjaoui, PhD, University of Picardie, France

- Linear and nonlinear models (transport, waves and optics, dissipation and dispersion)

Joaquim Correia, PhD, University of Évora, Portugal

- Dynamics of image processing & parabolic-hyperbolic models
- Image denoising and restoration & viscosity solutions, shock capturing
- Image segmentation and the Level Set Method & characteristics, weak solutions
- Curves and signals & metrics, dynamic geometry and scales.

5. Computer implementation of PDEs

Youcef Mammeri, PhD HDR, University of Picardie, CNRS, INRA, France

This lecture is dedicated to the implementation of methods presented in the other lectures. This course is done on computer.

- Scipy routines for image manipulation
- Fast Fourier Transform, Convolution, Filtering
- Finite differences implementation, Denoising, Inpainting.

TIME	DAY	WEDNESDAY 01/03	THURSDAY 01/04	FRIDAY 01/05	SATURDAY 01/06	SUNDAY 01/07
8:00-8:30		Opening			Excursion for everybody	Free
8:30-10:15		Noppadol	Noppadol	Noppadol		
10:15-10:45		break	break	break		
10:45-12:15		Bedjaoui	Bedjaoui	Costa		
12:30-14:00		lunch	lunch	lunch		
14:00-15:30		Pires	Pires	Pires		
15:30-17:30		group discussions	group discussions	group discussions		

Welcome

Dinner

TIME	DAY	MONDAY 01/08	TUESDAY 01/09	WEDNESDAY 01/10	THURSDAY 01/11	FRIDAY 01/12
8:30-10:15		Noppadol	Bedjaoui	Correia	Correia	Correia
10:15-10:45		break	break	break	break	break
10:45-12:15		Costa	Pires	Mammeri	Mammeri	group discussions
12:30-14:00		lunch	lunch	lunch	lunch	Closing lunch
14:00-15:30		Pires	Mammeri	group discussions	Mammeri	
15:30-17:30		group discussions	group discussions	Testimony	group discussions	

Each day was concluded by group discussions. Students were split in six groups composed by different (training and) countries and were working together to solve exercises given by the lecturers. Besides the exercises, 13.5 hours of classes were held on computer within a large room (1 computer per student) and two screens for simultaneous projection.

Saturday 06 January, everybody enjoys a full day of excursion inside the Chaipattana Career Park, the Don Wai Floating Market, the Molding factory of Prof. Mana Taiwuttanakul and the Phra Pathom chedi.

VI. Conclusion

According the opinion of participants, staff, teachers, lecturers and organizers, this SEAMS School was a great success. Participants had an overview of the importance of the theoretical and numerical basis to handle image (computer) processing through partial differential equations.

The testimony was an opportunity to learn more about the expectations and sentiments of the students. The distribution of the courses was appreciated and the 10-days school was considered a bit short by the students.

The gender balance in terms of participants was respected (50% of female). The budget was met.

It was a great opportunity for students of the region to meet each other and we wish they will collaborate in the future (this has been explicitly stated by the organizers and lecturers has a major goal of SEAMS schools).

This school has also been prolific for teachers. It has strengthened the links with Thailand both in terms of future training and in terms of research. Two days after the school, a meeting was organized with representatives of Silpakorn University (Thailand), Birla Institute of Technology & Science of Pilani (India), Quy Nhon University (Vietnam), National University of Laos (Laos), University of Évora (Portugal) and University of Picardie (France).

J. Correia, M. Pires, and Y. Mammeri stayed in the Silpakorn University to pursue the lectures and preparing international projects applications.

VII. Financial Report

See appendix for details.

We would like to mention that it would not have been possible to host so many foreign participants without the immense support of the Silpakorn University which, in addition to supporting 5 rooms for Thai participants, has financed another 5 rooms. We would also like to thank Caraga State University for taking over the transport between Butuan and Manila for the two Philippines participants.