

Report on
West Asia Mathematical Schools
WAMS
entitled
Iterative Methods For Solving The Boundary's Data
Reconstruction Problems

From 18 to 29 December 2016

Place of the school

Department of mathematics, College of Sciences, University of Salahaddin, Erbil, Kurdistan-Iraq.

Sponsors

CIMPA, IMU, French Embassy, University of Salahaddin and University of Diyala.



Coordinators

- **Abdeljalil Nachaoui**, Laboratoire de Mathématiques-Jean Leray, Université de Nantes, France Phone +33251125937 E-mail : Abdeljalil.Nachaoui@univ-nantes.fr
- **Fatima M. Aboud**, Department of mathematics, College of Sciences, University of Diyala. Phone +9647700397254 E-mail : fatimaaboud@yahoo.com

Lecturers

- **Abdeljalil Nachaoui**, Laboratoire de Mathématiques Jean Leray, Université de Nantes, France (Abdeljalil.Nachaoui@univ-nantes.fr).
- **Fatima M. Aboud**, Department of mathematics, College of Sciences, University of Diyala, Iraq (Fatima.Aboud@sciences.uodiyala.edu.iq).
- **Mourad Nachaoui**, Department of Mathematics, University of Sultan Moulay Sliman Beni Mellal, Morocco (Mourad.Nachaoui@univ-nantes.fr).

Scientific committee

- **Abdeljalil Nachaoui**, Laboratoire de Mathématiques Jean Leray, Université de Nantes, France (Abdeljalil.Nachaoui@univ-nantes.fr).
- **Abdelkrim Chakib**, Department of Mathematics, University of Sultan Moulay Sliman Beni Mellal, Morocco (Abdelkrim.Chakib@univ-nantes.fr).
- **Tamaz Tadumdze** (Institute of Applied Mathematics, Tbilisi State University, Tbilisi, Georgia), tamaz.tadumadze@tsu.ge

Local Organizing committee

- **Chair:** Dr Herish Omer, College of Sciences, department of Mathematics, University of Salahaddin (herish_omer69@yahoo.com)
- **Co-chair :** Dr Rostam Karim Saeed, College of Sciences, department of Mathematics, University of Salahaddin (rostamkarim@yahoo.com).
- **Member :** Dr Khwazbeen Saida Fatah, College of Sciences, Department of Mathematics, University of Salahaddin-Erbil (khwazbeen@yahoo.com).
- **Member :** Karzan Ahmed, College of Sciences, Department of Mathematics, University of Salahaddin-Erbil (karzan.ahmad@yahoo.com).

History and context

Since 2008, the CIMPA organizes scientific activities in the domaine of mathematics and its applications in cooperation with the Iraqi Universities. A group of workshops and intensive courses take place in every year in different Universities in the Kurdistan region of Iraq with a participations of a lot of researchers from different regions of Irak. Also a CIMPA school taken place in Erbil during 2014 and two WAMS during 2015.

This school is the third one, supported by CIMPA and organized in the region of Kurdisatn.

This research school is based on the analysis of the problem of reconstruction of data on the boundary, known as the Cauchy problem, using iterative algorithms inspired by domain decomposition methods.

The aim of this WAMS was to introduce students and non-experts in the field domain decomposition methods to build momentum around some inverse problem topics that covers many areas of research ranging from modelling to simulation through mathematical analysis of partial differential equations as well as the development of new solution algorithms.

The scientific program of this school included theoretical and practical lectures and time reserved for participants to present their works, the objective of this last possibility was to give the possibility to the participants to introduce them field of research to the other participants, to encourage those who cannot afford to go exhibit in international conferences.

The course started by presenting the theoretical basis of domain decomposition methods. Secondly we gave the adaptation of these methods to obtain efficient algorithms for solving the Cauchy problem. Then we have talked about the implementation of the finite element method for the resolution of "associated direct problems."

During the practical part the participants used FreeFem++ (a software created by French mathematicians to solve boundary value problems using finite element method) which they have discovered during the school. For this, the French and the Moroccan lecturers have cooperated with the The information technology service technician to install a new version of FreeFem++ at the computer room used by the participants during the school. In fact one of the aim of the school was to give some ideas about the programming by using FreeFm++ to solve boundary values problems numerically. The fact that participants solved themselves problems by FreeFem++ made them feel the importance of each condition and each mathematical term appeared in the theoretical part and prepared them to solve similar problems independently.

Participation

Events in Iraq discouraged several foreign participants who had expressed interest in participating.

The participants came from different regions and different Universities of Iraq and the participation of women is about 35% of the total of participation.

In the end, the school brought together some 47 mathematicians, beginners and advanced (see annex for the list of participants), including 25 Kurds and 22 Iraqis from outside Kurdistan. Some scientists from other departments (physics and biology) of the University of Salahaddin have attended some courses.

We have noticed a very low participation of mathematicians from other universities in Kurdistan (Dohuk and Sulaimaniah). The weakness of the participation of these universities is a source of regret for us. We told the local organizers. They explained that it is very difficult to bring colleagues from other cities under the current conditions (some universities are on strike because of the delay in paying several months of salaries).

Material conditions

All the activities of the school took place at Salaheddin University. Almost all participants were accommodated at the guest house of this university. Most of the midday meals were taken collectively on site.

For the courses, we have a very comfortable amphitheater equipped with an excellent video projector and a large white board. We were able to have a self-service computer room.

Overall, it can be said that the material conditions were very good. In addition, Salaheddin University has provided us with a mini bus for an excursion to the mountainous region of Korek.

Courses, and Communications

The school was inaugurated by a short opening session in which the University of Salaheddin was represented by Professor Herish, Dean of the College of Science. Professor Ahmed Dezaye, President of the University, was also expected to attend the opening session, but was unable to attend due to an impediment.

The school's science program consisted of several one-and-a-half-hour sessions and several two-hour practical sessions. Half-hour slots were also scheduled to allow participants who wished to present their work. Two talks were presented.

All courses started with detailed reminders and motivations. The level, rhythm and content of the presentations seem to have been well adapted to the public. The many questions that followed each session reflect the great interest that the participants found at this school.

During the school, there were many discussions between participants and speakers, **a proposition of cooperation project in doctoral thesis supervision with the split-site system between the University of Salahaddin and the University of Nantes.**

Courses

See Program of the school

Communications

Graph Theory and applications:

Assist. Prof. Dr. Abdul Jalil M. Khalaf, University of Kufa, Najaf

The opposite effect of Wnt5a on Melanoma" which is in the field of Mathematical Biology

Dr. Mohammed Rasheed,

Department of Mathematics, College of Science, University of Kirkuk

Financial support

This school could not take place without the financial support of the sponsors, so many thanks to each of the French embassy-Bagdad, CIMPA, IMU, University of Salahaddin and University of Diyala. The total budget of the school is 15583 Euros. The number of participants is 47, the percentage of the participation of the sponsors in the total budget of the school is as the following :

French Embassy	15.2%
CIMPA	32%
IMU	6.4%
Salahaddin University	31.7%
Diyala University	12.7%
Participation of the coordinators of the School	2%

Program of the school-First Week
14h30 hours Theoretical courses – 10h30 hours Programming courses

3 hours of communications

Date	Sunday: 18 December 2016	No of hours
9:30-11:00	Abdeljalil Nachaoui, Introduction and motivations	1h30
11:00-11:30	Break	
11:30-13:00	Fatima Aboud, A review of analysis, Basic function spaces	1h30
13:00-14:00	Lunch	
14:00-16:00	Fatima Aboud, Hilbert space, Green's representation formulas and applications	2h
Date	Monday: 19 December 2016	
9:30-11:00	Fatima Aboud, Distributions, Sobolev spaces	1h30
11:00-11:30	Break	
11:30-13:00	Fatima Aboud, Density of smooth functions and trace, Sobolev embedding theorems	1h30
13:00-14:00	Lunch	
14:00-16:00	Abdeljalil Nachaoui, application examples	2h
Date	Tuesday: 20 December 2016	
9:30-11:00	Fatima Aboud, Poincaré inequality, General Sobolev inequalities	1h30
11:00-11:30	Break	
11:30-13:00	Fatima Aboud, application examples	1h30
13:00-14:00	Lunch	
14:00-16:00	Fatima Aboud, Abstract variational problems, General second order elliptic problems	2h
Date	Wednesday: 21 December 2016	
9:30-11:00	Abdeljalil Nachaoui, Variational approximation methods for elliptic PDEs	1h30
11:00-11:30	Break	
11:30-13:00	Abdeljalil Nachaoui, Introduction to finite element methods	1h30
13:00-14:00	Lunch	
14:00-16:00	Abdeljalil Nachaoui, Finite element method implementation Issue	2h
Date	Thursday: 22 December 2016	
9:30-11:00	Abdeljalil Nachaoui, Introduction FreeFem++	1h30
11:00-11:30	Break	
11:30-13:00	Mourad Nachaoui, FreeFem++: Meshes generation	1h30
13:00-14:00	Lunch	
14:00-16:00	Mourad Nachaoui, Programming with FreeFem++	2h
Date	Friday: 23 December 2016	
Social Program		
Date	Saturday: 24 December 2016	
9:30-12:30	Communications by participants:	3h
9:30-11:00	Graph Theory and applications: Assist. Prof. Dr. Abdul Jalil M. Khalaf University of Kufa, Najaf	
11:00-12:30	The opposite effect of Wnt5a on Melanoma" which is in the field of Mathematical Biology Dr. Mohammed Rasheed, Department of Mathematics, College of Science, University of Kirkuk	
12:00-13:30	Lunch	

Program of the school-Second Week
8h30 hours Theoretical courses – 12h hours Programming courses
1h30 Seminar and 1h30 Theoretical and programming evaluations

Date	Sunday: 25 December 2016	No. of hours
9:30-11:00	Abdeljalil Nachaoui, Domain decomposition: Overlapping methods	1h30
11:00-11:30	Break	
11:30-13:00	Mourad Nachaoui, Domain decomposition: Methods without overlap	1h30
13:00-14:00	Lunch	
14:00-16:00	Abdeljalil Nachaoui, Domain decomposition: Programming with FreeFem++	2h
Date	Monday: 26 December 2016	
9:30-11:00	Mourad Nachaoui, Domain decomposition: Programming with FreeFem++	1h30
11:30-11:30	Break	
11:00-13:00	Abdeljalil Nachaoui, domain decomposition: Accelerated convergence and implementation with FreeFem++	1h30
13:00-14:00	Lunch	
14:00-16:00	Abdeljalil Nachaoui, Domain decomposition: variational Steklov–Poincaré theory	2h
Date	Tuesday: 27 December 2016	
9:30-11:00	Abdeljalil Nachaoui, Domain decomposition: Programming with FreeFem++	1h30
11:00-11:30	Break	
11:30-13:00	Mourad Nachaoui, Domain decomposition: Programming with FreeFem++	1h30
13:00-14:00	Lunch	
14:00-16:00	Mourad Nachaoui, Domain decomposition based methods for Cauchy problems: implementation with FreeFem++	2h
Date	Wednesday: 28 December 2016	
9:30-11:00	Abdeljalil Nachaoui, Domain decomposition based methods for Cauchy problems	1h30
11:00-11:30	Break	
11:30-13:00	Mourad Nachaoui, Domain decomposition based methods for Cauchy problem : implementation with FreeFem++	1h30
13:00-14:00	Lunch	
14:00-16:00	Abdeljalil Nachaoui, Recent research issue : implementation with FreeFem++	2h
Date	Thursday: 29 December 2016	
9:30-11:00	Evaluations : implementation with FreeFem++	1h30
11:30-11:30	Break	
11:00-13:00	Evaluations: implementation with FreeFem++	1h30
13:00-14:00	Lunch	
14:00-16:00	Cloture of School	2h

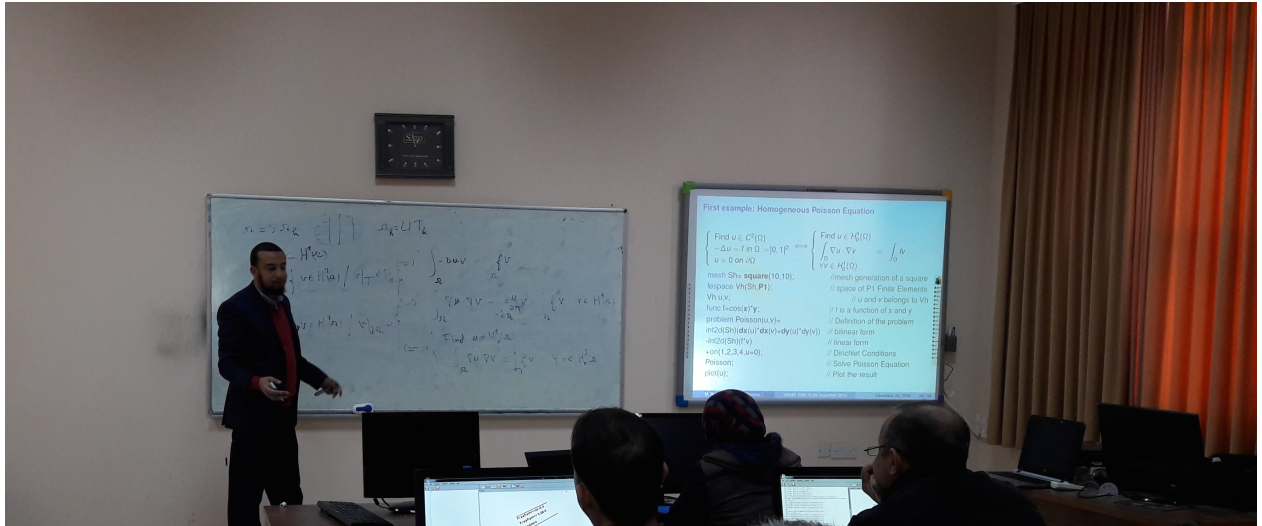
List of participants

	Full name	University and college
1	Mr Abdeljalil Nachaoui	Universite de Nantes
2	Miss Fatima Aboud	University of Diyala
3	Mr Mourad Nachaoui	University of Sultan Moulay Sliman Beni Mellal, Morocco
4	Mr Herish Omer	Salahaddin University-College of Science
5	Miss Khwazbeen Saida Fatah	Salahaddin University-College of Science
6	Mr Rostam K. Saeed	Salahaddin University-College of Science
7	Miss Asmaa Khawam	University of Diyala
8	Mr Ghasan Aldouri	University of Tikrit
9	Mr Mousa Makey Khrajan	Al-Muthanna University/Science College
10	Mr ALAA ADNAN AUAD	University of ALAnbar
11	Mr Sarkash Khalid Ridha	University of Karkuk
12	Mr Kawa Mustafa Aziz Manmi	Salahaddin University-College of Science
13	Mr Waleed Hussain Aziz	Salahaddin University-College of Science
14	Miss Hazha Zirar HUSSAIN	Salahaddin University-College of Science
15	Miss Awreng baiz mahmood	Salahaddin University-College of Science
16	Mr Andam Ali Mustafa	Salahaddin University-College of Science
17	Mrs Gashaw A. Mohammed Sa	Salahaddin University-College of Science
18	Miss Ala Omer	Salahaddin University-College of Science
19	Mr Abdullallah Abdeljabar	Salahaddin University-College of Science
20	Mr Karzan Ahmed	Salahaddin University-College of Science
21	Miss Payman Abbas Rashed	Salahaddin univ-Collage of Basic Education
22	Miss Evar Lutfalla Sadraddin	Salahaddin univ- College of science
23	Mr Imad A. Aziz	Salahaddin University-College of Science
24	Miss Asmaa N. Al-Janabi	University of AL-Moustansriya
25	Miss Shatha sami sejad Alhily	University of AL-Moustansriya
26	Ahmed Murshid	University of Diyala
27	Waleed Hussain Aziz	Salahaddin University-College of Science
28	Miss Dalya Abdullah Anwer	Salahaddin University-College of Science
29	Sami Ali Hussein	Salahaddin University-College of Science
30	Miss Nabaa Najdi Hasan	University of AL-Moustansriya
31	Abdul Jalil M. Khalaf	Kufa University
32	Rifaat Saad Abdul Jabbar	AL-Anbar University
33	Ghassan Ezulddin Arif	University of Tikrit
34	Dr Abas H. K. Ibrahim	University of Karkuk
35	Mahammed AM Rassheed	University of Karkuk
36	Raheam Mansor AL-SAPHORY	University of Tikrit
37	Naseif J. Al-Jawari	University of AL-Moustansriya
38	Radhi Ali Zaboon	University of AL-Moustansriya
39	Saad Naji Ali Al-Azzawi	University of Bagdad
40	Dr. Mushtaq Shakir A.hussein	University of AL-Moustansriya
41	Ahmed Hassan Hamshen	Salahaddin University
42	Miss Goran muhammad khalil	Salahaddin University
43	Miss Ronak Mohammed Saeed	University of Karkuk
44	Miss Huda Al-Mashhadany	University of Ninava
45	Mr HUNAR Sherzad Taher	Salahaddin University-College of Science
46	Mr DARAWAN Zrar Muhmad	Salahaddin University-College of Science
47	Miss Bahar O Ali	Salahaddin University-College of Science

Some Photos









During the practical part



Communication by participant:Dr. Mohammed Rasheed



Communication by participant: Dr. Abdul Jalil M. Khalaf

Some Important Links

- CIMPA: <http://www.cimpa-icpam.org/>
- IMU: <http://www.mathunion.org/>
- University of Diyala: <http://www.uodiyala.edu.iq/>
<http://www.en.sciences.uodiyala.edu.iq/>
- University of Salahaddin: <http://su.edu.krd/>
<http://science.su.edu.krd/>
- Workshops website: <http://science.su.edu.krd/Old/workshop/>
- Gallery of Photos: <http://science.su.edu.krd/index.php/explore/maths/gallery>