

## 2017 IEEE CSS Winter School on Cyber-Physical Systems Funded by the IEEE CSS Outreach Fund

### **Organizing Committee**

General Chair: Prof. Seshadhri Srinivasan, Kalasalingam University

Administration Chair: Prof. V. Vasudevan, Kalasalingam University

Program Chair: Prof. Jagannathan Sarangapani, Missouri University of Science and Technology

Jan 8, 2017

The Department of Instrumentation and Control Engineering, Kalasalingam University located at Virudhunagar District, Tamilnadu, India hosted the 2017 IEEE CSS Winter School on CPS funded by the IEEE CSS Outreach fund during January 5-8, 2017.

The Cyber-Physical Systems (CPS) have highly coupled physical and cyber parts. The biggest challenge in CPS is understanding the different domains and unifying them in a single framework. The aim of the winter school is to bridge the gap between the different participating domains and highlight the role of IEEE CSS in the field of CPS. The winter school provided a platform for young researchers, experienced academicians and persons from industries to share their experiences and to form an interest group to further interact and advance this area. The winter school delved on recent developments in CPS with diversified lectures from both academia and industries. It also demonstrated successful results from recent research projects on CPS in Europe. The main objective was to bring together people from different backgrounds working on CPS and to provide them a common platform with lectures that range from the basics to recent results in this area. The lectures started with an Introduction to CPS a followed by lectures on optimization, design methodologies, formal methods, verification of CPS, and applications covering energy systems, building energy management, medical electronics and industrial applications. The winter school provided a range of discussions among the speakers from academia and industries with participants from different levels. It attracted participants from eight different countries and from various industries.

## **1, Highlights**

Two IEEE Fellows and five Senior Members participated in the event. There were one hundred and sixty (160) registrants for the event from eight different countries and thirty eight (38) participants from Industry. During the event experts from different areas of CPS spoke on the current state-of-the art research and also the future directions in CPS. The distinguished invited speakers included—Prof. N. Sundararajan, Nanyang Technological University, Singapore; Prof. Jagannathan Sarangapani, Missouri University of Science and Technology; Prof. Luigi Glielmo, University of Sannio, Italy; Prof. Juri Vain, Tallinn University of Technology, Estonia; Dr. Suresh Sundaram, SCSE, NTU, Singapore; Dr. Srin Ramaswamy, ABB Inc, USA; Dr. Ramkrishna Pasumarthy, EE Dept, IIT Madras; Prof. Lakshmi Narasimhan, University of Botswana; Dr. Hariprakash, IEEE CSS Madras Section; Dr. H.R. Mohan, IEEE Madras section; Dr. Rohith Warriar, Jothydev Hospitals, Trivandrum; Dr. Nagedra Kumar Suryadevara, GEC, Hyderabad, India; and Prof. Seshadhri Srinivasan, KLU spoke on different aspects of CPS.

There were also other events such as a special lectures on funding opportunities in France for research in CPS, and an excellent cultural and musical events for the participants to relax from the tight technical program. In addition to the funding from the IEEE CSS Outreach fund, the event also attracted funding from ABB Global Industries and Services Pvt. Ltd., Bangalore, CSIR, HRDG, India, Integratech, Singapore, M/s Vijaynicole Imprints Pvt. Ltd., Chennai, and Seshashayee Paper Boards, Tirunelveli.

## **2. Participants**

There were 150 participants from 8 countries (US, Ethiopia, Singapore, Taiwan, Srilanka, Estonia, Botswana, and India). In addition, there were attendees from the local IEEE Chapter and funding organizations. There were around 38 participants from Industries and 122 from academia. The distribution of participants is provided in Annex 1.

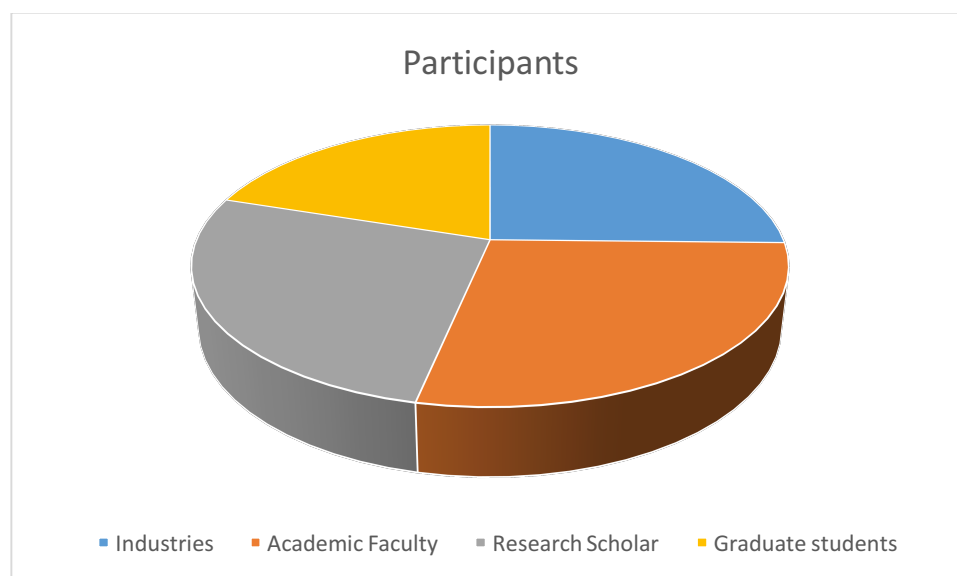


Figure 1: Distribution of Participants

### **3. Funds Raised**

Other than the funding from IEEE CSS Outreach fund the following sponsorships were raised to run the program

1. Council of Scientific and Industrial Research, Human Resource Development Group – 50000 INR which is equivalent to 800 USD
2. ABB Indian Corporate Research Center- 1000 USD
3. Seshasayee Paper Boards- Notepads for the event
4. Integratech- Sponsorship for the winter school kit
5. First Planet- Internet and other hosting material
6. Department of Instrumentation and Control Engineering, Kalasalingam University, Printing material for the winter school.

### **3. Outcomes from the winter school**

- The winter school brought together researchers working in the area of CPS in India in one platform and provided good insights to students from a rural University exposure as well as contacts to pursue research in CPS.
- Efforts are on to start an IEEE CSS chapter within the Kalasalingam University and an interest group of young researchers has been formed on the CPS.
- An email list of participants interested in CPS has been formed. Research collaboration with industries will be established using the contacts created during the event.
- IEEE CSS Student memberships will be encouraged and partial support will be provided by the University.
- As a follow-up to the event a Master's course is being planned on Embedded Systems with special emphasis on Cyber-Physical Systems. The course will be jointly organized by the Kalasalingam University along with DA-IICT, Ahmedabad. The course will have external supervisors from the CPS winter school- Prof. Luigi Glielmo, Prof. Juri Vain, and Prof. Suresh Sundaram, supervising the students and offering a joint-project.
- A follow-up winter school with the experts and additional ones from other Institutes is being planned in DA-IICT, Ahmedabad, India.
- The General Chair of the winter school, will organize a special lecture in the CPS Summer School organized by Peter Gorm Larsen, Arhus University, Denmark in Romania as part of the INTO-CPS project.
- A special session on CPS will be organized in Indian Control Conference 2017 and European Control Conference in 2019 by the organizers of the winter school. Two of the participants from the winter school are involved in the organization of these events.

### **4. Schedule:**

The final schedule of the winter school is given in Table 1.

### **5. IEEE Activities during the winter school**

The following activities were/will be performed for increasing the IEEE CSS membership during the winter school

1. Initiate to start an IEEE CSS branch within the University. The local Madras section has been informed about the intention and the membership enrolment of the faculty/students is underway for bringing up the CSS branch.
2. Regular technical talks will be organized using the web-conferencing and also inviting faculties from other Universities using the IEEE CSS chapter in the University.
3. Drive for student membership was conducted during the winter school and the University has proposed supporting the activity. The General Chair and Student Branch Counsellor announced sharing their Sr. Membership elevation gift cheques given by IEEE for the student members trying to enrol after the winter school.
4. The local IEEE Madras CSS chapter and IEEE Madras section presented their activities during the winter school. The participants were introduced to the local chapter which is expected to trigger membership drives.
5. Newspaper articles were published on the winter school, both in National and local ones.
6. Advertisements were published on the winter school acknowledging the contributions of the IEEE CSS Outreach fund.
7. The winter school provided good visibility for the IEEE CSS activities and attracted young researchers and industrial participants alike.

## 6. **Impact:**

1. The Honourable Prime Minister of India, while addressing the Indian Science Congress at Tirupati on 4.01.2017 highlighted that research in Cyber-Physical Systems in India was important for national and global development. The event which happened just one day before the start of the winter school reveals the timing and aptness of the topic. This has opened up many young researchers to enter the field of CPS and make contributions in future. This winter school is timely and created awareness in technical community in India and neighbouring countries.



2. The first impact of the program catered to the research and educational activities of an under-developed region in India. The University programs cater to wide variety of audience including a “Speech and hearing impaired program (or SHIP), a unique program in entire Asia. The CPS winter school registration was allowed free for the SHIP students and was received well by both the audience and SHIP students.
3. The funding was instrumental in bringing experts and audience to discuss on CPS. This has triggered a range of collaborative activities:
  - a. The program provided a fillip to the research activities in the region and an interest group of researchers has been formed. In addition, the winter school enabled interaction with participants from 8 countries having varied background.
  - b. A joint Bachelor’s and Master’s program with faculty and resource mobility between two Indian Universities- Kalasalingam and DAIICT, Gandhinagar, India with support from Universities in Europe. This will spurt the research activities in CPS and basic educational activities in the Universities.
  - c. Using this program, Industries and Academics came closer and there have been agreements on starting joint projects and also for industry participation in University programs.
  - d. The CSS funding was a major catalyst to start an IEEE CSS chapter at the University. The local Madras section is advising us on this.
  - e. The funding created impetus for developing student research and training opportunities in CPS.
  - f. Inter-University collaborations have been forged both within India and Europe, the program by itself attracted funding for some participants from the DORA initiatives of a European government and future Erasmus partnerships were proposed.
  - g. The event highlighted one of the IEEE CSS Outreach fund initiatives to serve the needs of the society and deliver the technical content to the underprivileged. Without this funding, it would not have been possible for the audience to hear the distinguished lecturers who spoke during the event and interact with them.
  - h. The activities of the winter school (e.g., on Cyber-security) will contribute further for the recent initiatives of the Indian Government on Digital India, Make in India and Startup India.

<b>Time</b>	<b>January 05, 2017 Day 1</b>	<b>January 06, 2017 Day 2</b>	<b>January 07, 2017 Day 3</b>	<b>January 08, 2017 Day 4</b>
<b>09.30 - 11.00</b>	<b><i>An overview of the Winter School and Introduction to CPS</i></b>  <b>Dr. Jagannathan Sarangapani</b> Missouri University of Science and Technology, USA	<b><i>Event Triggered Systems and Optimal Control of CPS</i></b>  <b>Dr. Jagannathan Sarangapani</b> Missouri University of Science and Technology, USA	<b><i>Intelligent Optimization</i></b>  <b>Prof. N. Sundararajan</b> NTU, Singapore	<b><i>Implementing CPS with XBEE</i></b>  <b>Dr. Nagender Kumar Suryadevara</b> Geethanjali Engg. College, Hyderabad
<b>11.15 - 12.45</b>	<b><i>Optimization in CPS</i></b>  <b>Prof. Luigi Glielmo</b> University of Sannio, Italy	<b><i>Cyber-Physical Energy Systems</i></b>  <b>Prof. Luigi Glielmo</b> University of Sannio, Italy	<b><i>Intelligent Techniques for CPS</i></b>  <b>Dr. Suresh Sunadaram</b> NTU, Singapore	<b><i>CPS in Industrial and Grid Automation</i></b>  <b>Dr. Srin Ramaswamy, ABB, USA, Mr. Ravish Kumar, ABB, India and Dr. Seshadhri Srinivasan, KLU</b>
<b>2.00- 3.30</b>	<b><i>CPS Model Verification- Introduction to Formal Methods</i></b>  <b>Prof. Juri Vain</b> Tallinn University of Technology	<b><i>CPS in Medicine: The case-study of Artificial Pancreas</i></b>  <b>Dr. Rohith Warriar</b> Jyothydev Hospital	<b><i>Overview of the INTO-CPS Technology</i></b>  <b>Prof. Peter G. Larsen</b> Arhus Univ., Denmark	<b><i>Methods in CPS</i></b>  <b>Prof. Ramkrishna Pasumarthy, IIT Madras</b>

3.45– 5.15	<p align="center"><b>Verifying Timing Performance in CPS</b></p> <p align="center"><b>Prof. Juri Vain</b> Tallinn University of Technology</p>	<p align="center"><b>CPS View of Buildings</b></p> <p align="center"><b>Prof. Seshadhri Srinivasan</b> KLU, India</p>	<p align="center"><b>Distributed Model Based Testing</b></p> <p align="center"><b>Prof. Juri Vain</b> Tallinn University of Technology</p>	<p align="center"><b>Valedictory Function</b></p>
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### Special Events

	5.01.2017	6.01.2017	7.01.2017	8.01.2017
17:30-18:30	<p><b>ACM/IEEE Perspectives on CPS</b> Prof. Lakshmi Narasimhan, University of Botswana</p>	<p><b>Research Opportunities for scientists in CPS in France</b> Dr. Srinu Kaveri, Director, CNRS France</p>	<p><b>Open Forum- Interaction with participants with Winter School Speakers</b></p>	
19:00-19:45	<p><b>Yoga for all</b></p>	<p><b>Musical Program</b></p>	<p><b>Cultural Programs</b></p>	
19:45-21:00			<p><b>Winter School Banquet</b></p>	

Table 1 Winter School Schedule

## 8. Conclusions

The IEEE CSS winter school served as a platform for interaction among interested group of researchers, practitioners and academia. The CSS funds impacted the development of CPS research in the region and is expected to trigger significant interest among the participants. An email list has been prepared to create an interest group that will form a forum for exchanging information. The Outreach fund has provided a fillip to the research activities in the region and the activities will be sustained in near future.

The IEEE CSS winter school was a very successful event as can be evinced from the number of participants, interest expressed by industries, and research scholars present. The winter school also had good representation from different countries, industries and addressed different application domains such as- energy, industrial automation, medicine and buildings. The presentations were carefully delivered, the topics were rated to be very relevant and have triggered research in CPS among the participants. The participants also enjoyed the stay, hospitality, and social events organized during the winter school.

As the winter school received good funding support from outside, due to increased requests from students of the University, the student admissions were discounted by 50% concession. We expect this will provide the much needed thrust to establish an IEEE CSS chapter in the University.

## 9. Acknowledgements

The organizers thank the IEEE CSS Outreach fund task force, Kalasalingam University, ABB Global Industries and Services Pvt. Ltd., CSIR and other funding organizations for sponsoring the event. The organizers thank the IEEE CSS Outreach task force to have funded the event in a rural locality and for providing suggestions for the successful organization of the event. The organizers also thank- Prof. N. Sundararajan, Prof. Jaggannathan Sarangapani, Prof. Luigi Glilemo, Prof. Juri Vain and Prof. Sundaram Suresh for providing suggestions and being involved in the organization of the winter school from the first day. The local IEEE Madras section provided good support in administration. In particular, the organizers thank Prof. Atmanand, for his quick suggestions and replies. The IEEE CSS Madras section for its role in organizing and attending the event. We also thank Mr. Sakthivel, Treasurer, IEEE Madras Section and Dr. H.R. Mohan, Past Chair, Madras Section for supporting our initiatives. Above all, we thank Prof. Daniel Riviera, Director, Task force, IEEE CSS Outreach fund for his guidance and suggestions in organizing the event and supporting our initiatives.



## Annex 1: Participants

Organization	No. of Participants
ABB	10
CSIR	2
Integratech	2
Josh Automation	2
FLSmidth A/s	2
Smarta	2
CTS	2
ZFTVS	2
GM	1
HCL	2
CTS	2
SPB	2
KKNPL	2
DAIICT	1
NTU, Singapore	2
SAASTRA University	6
VIT	5
Gojan Business School	2
NIT-Trichy	1
University of Moratuwa	1
PESIT	2
Thiagarajar College of Engg.	1
Tallinn University of Technology	2
IEEE chapter Members	2
SSN Engineering College	1
Syed Ammal Engineering College	1
KLN College of Engineering	1

National Engineering College	1
PSR College of Engineering	1
Gondar University, Ethiopia	2
Tseng Chia University, Taiwan	1
SRM University	2
Sri Vidhya College of Engineering	2
Sethu Institute of Technology	4
Kalasalingam College of Engineering	2
Anand Institute of Higher Technology, Chennai	2
Research Scholars from KLU	40
Students from KLU	39
Total	151

## Annex 2: Budget (Tentative- not finalized)

<b>Funding/Income</b>		
IEEE CSS Outreach fund	5000 USD	
ABB GISL funding	1000 USD	
CSIR, HRDG	800 USD	
Integratech and Vijay Nicole Imprints and SPB	1000 USD	In kind contribution for the kit
Kalasalingam University	12000 USD	Accommodation, organization, food and other support
Registrations	2000 USD	
<b>Total</b>	<b>20800 USD</b>	
<b>Expenditure</b>		
Travel and Accommodation of Speakers	7000 USD	Mostly covered from IEEE Funds
Honorariums	1300 USD	
Accommodation	4000 USD	
Local transport	1000 USD	
Printing of brochures, flex boards, digital display	500 USD	
Food and Hospitality	3500 USD	
Lecture material and kits	1000 USD	
Conference rooms and organization	1200 USD	
Overhead charges and Miscellaneous expenses	1300 USD	
<b>Total Expenditure</b>	<b>20800 USD</b>	Plus advt.'s in National News papers

Annex 3: Photos from the event



Figure 1: Prof. Jagannathan Sarangapani addressing the gathering



Figure 2: Inauguration of the IEEE CSS Winter School



*Figure 3: A group photo during the winter school*



*Figure 4: Interaction between IEEE CSS Local Chapter and University Administrators*



Figure 5: Section of the Audience



Figure 6: Prof. N. Sundararajan Speaking during his felicitation



*Figure 7: Interaction with the Industries during the event*



*Figure 8: Section of audience and cultural event as part of the Winter School*





Annex 4: Newspaper, Flex and Digital boards, and local media coverage

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**IEEE** **CSS**  
**DEPARTMENT OF**  
**INSTRUMENTATION AND CONTROL ENGINEERING**  
A Four Days IEEE Winter School on  
**CYBER PHYSICAL SYSTEMS**  
(Funded by IEEE CSS Outreach Fund)  
03.01.2017 to 03.01.2017

**Invited Speakers**

- Mr. T. Kalasalingam**, Founder - Chairman
- Dr. K. Sridharan**, Chancellor, Kalasalingam University
- Dr. S. Shaji Anand**, Director, Kalasalingam University
- Mr. S. Arjun Kalasalingam**, Director, Kalasalingam University
- Prof. N. Sundarajan**, Nanyang Technological University, Singapore
- Prof. Jagannathan Sarangapani**, Missouri University of Science Technology, USA
- Prof. Luigi Glielmo**, University of Genoa, Italy
- Dr. Sri Ramaswamy**, ABB, Inc, USA
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- Prof. Peter G. Larsen**, Aarhus University, Denmark
- Prof. Suresh Sundaram**, Nanyang Technological University, Singapore
- Dr. Ramakrishna Pasumarthy**, IIT Madras, India

**Additional Speakers**

- Dr. Seshadhri Srinivasan**, KLU - General Chair
- Dr. Ravish Kumar**, ABB, Bangalore
- Dr. Nagendra Kumar Suryadevara**, IEC, AP
- Dr. Rohit Warriier**, Jyothydev Research Centre, Kerala

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**Dr. S. Saravanasankar**, Vice Chancellor

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Figure 9: Advertisements released to the Indian Express and The-Hindu, India's leading National dailies

News articles in dailies



Figure 10: News article in National Newspapers



Figure 11: News article in local Newspaper



Figure 12: News article in local newspaper

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**Resource Persons**

**Sponsors**  
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Figure 13: Flex Boards and Digital Displays for the event

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Figure 14: Flex boards erected as part of the event in the venue and 5 other places

Annex 5: Additional and Cultural Programs



Figure 15: Cultural event during the winter school



Figure 16: A fusion of Western and Indian Classical during the event