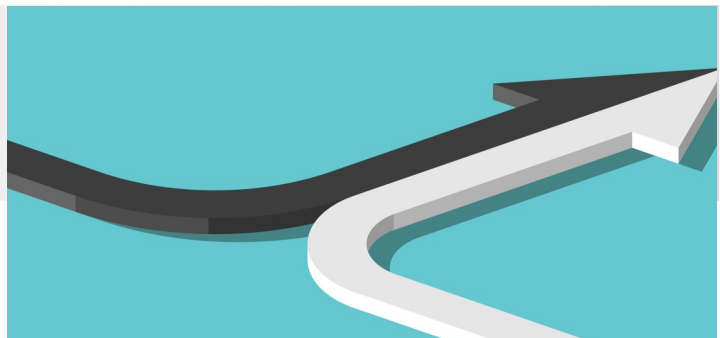


iTrust Times

A Quarterly Newsletter

Issue Highlights:

- ◆ iTrust Lab Phase 2 *pg. 2*
- ◆ Distinguished Paper Award *pg. 2*
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Oct–Dec 2023 | Volume 9 Issue 4

Dear readers,

Happy New Year to all friends of iTrust! 2023 is a special year for iTrust. In the past 10 years, iTrust has grown to become a well-established cybersecurity research centre.

In Q4 of 2023, iTrust has kept active in cybersecurity research and education, as well as cyber exercise. We were awarded the grant for [iTrust Lab](#) Phase 2 in October 2023,

which is essential for the operation of iTrust OT testbeds. We would like to thank CSA for its sustained and strong support to iTrust Labs, so that we can continue to contribute to creating a safer and more secured OT landscape.

iTrust is managing the [CiMS](#) scholarship programme which aims to grow and develop a pool of cybersecurity professionals in Singapore. Since its inception in July 2022, we have awarded the scholarship to 12 MSSD students. Congratulations to all the recipients, and it is our hope that this scholarship will provide the additional motivation to study hard and excel. The application will open again soon, and we look forward to more applications.

Our research work on analysing semantics of controller variables in industrial control systems was published at the 39th Annual Computer Security Applications Conference and received the distinguished paper award. The leading author is Jie Meng, a visiting PhD student from Zhejiang University.

iTrust has been actively supporting national and international cyber exercises through its unique OT testbeds. In Apr, an iTrust-developed digital twin was used in Exercise Locked Shields organised by NATO CCDCOE, and in Nov, a national cyber exercise (CIDeX) organised by the Digital and Intelligence Service.

We are seeking deeper international collaborations to expand the influence and reach of iTrust. Assistant Director Mark Goh and Cyber Tech Lead Francisco Furtado visited a few international partners in Europe in November 2023.

Looking ahead, 2024 will be a busy year for iTrust. Research pace on maritime cybersecurity is expected to pick up and more exciting elements will be added to cyber exercises. We will organise the 1st International Conference on the Design of Cyber-Secure Water Plants ([DCS-Water'24](#)) at Buford, Georgia, USA on 23-24 April 2024, as well as ACM [AisaCCS'24](#) in Singapore on 1-5 July 2024. We look forward to closer collaboration with partners from academia, industry and government agencies in the new year.

Jianying Zhou

Centre Director, iTrust, SUTD
Professor of Cyber Security, ISTD Pillar, SUTD



iTrust Lab Phase 2

In 2019, iTrust was awarded \$4M over 5 years by the National Research Foundation to support the operations of iTrust testbeds. Since then, its OT testbeds have gained a lot of traction in their influence and reach, supporting a host of local and international activities such as cyber exercises, R&D, training, and education.

Phase 2 will forge an ever-closer partnership with the National Cybersecurity R&D Laboratories (NCL), a national infrastructure that provides computing and networking resources for cybersecurity research and development community. The partnership includes an exchange of engineers between both labs to increase cross-exposure to IT and OT domains, joint training and outreach programmes and continued joint support of national- and international-level cyber exercises. On the award, Centre Director Prof Jianying Zhou said, “We would like to thank CSA for its sustained and strong support to iTrust Labs, so that we can continue to contribute to creating a safer and more secured OT landscape. We would also like to thank NCL’s partnership in our activities, such as hosting digital twins of our OT

testbeds for the iTrust annual exercise CISS, and look forward to deeper collaborations.”

Concurrently, NCL also had its funding approved for Phase 3 of its operations. NCL’s Principle Investigator Prof Chang Ee-Chien added: “We would like to thank CSA for its strong support. We are also grateful for the partnership with iTrust. Our combined IT-OT testbeds provides researchers, agencies, and industry users realistic cyber environments for their training, testing and research needs. We look forward to even closer collaboration in this new phase.”



Annual Computer Security Applications Conference 2023

A paper titled “SePanner: Analyzing Semantics of Controller Variables in Industrial Control Systems based on Network Traffic,” co-authored by Jie Meng, Zhenyong Zhang, Yangyang Geng, Ruilong Deng, Peng Cheng, Jiming Chen and iTrust Centre Director Jianying Zhou received the distinguished paper award at the 39th Annual Computer Security Applications Conference. Congratulations to all!

iTrust Laboratories Phase 1 Report Card

Duration: 2019 to 2023
 Funding Agency: Cyber Security Agency of Singapore

Testbed Usage	3,600 hours
SWaT WaDi EPIC IoT Training Skids	2,180 500 540 70 310
Testbed Datasets	11,800 requests
Academia & industry	4,000 entities
Countries	83
Professional Training	35 course runs
Participants	400
Training days	60
Organisations	28
Internship	103 interns
Local Overseas	89 14
IHLs Secondary schools	84 19
R&D Projects Support	> 30 projects

CSA-iTrust Master of Science in Security by Design Scholarship

Mr Stanley Tsang, Chairman of the Cyber Security Laboratories Singapore Governance Board, and Prof Jianying Zhou, iTrust’s Centre Director presented scholarship certificates to 12

recipients at an award ceremony on 11 Oct 2023. The recipients were awarded the CSA-iTrust Master of Science in Security by Design Scholarship (CiMS) Programme in the presence of their family and friends. Congratulations to all the scholarship recipients!

The CiMS was launched in Jul 2022 and aims to grow and develop a pool of cybersecurity professionals in Singapore and contribute towards one of the goals of Singapore’s Smart Nation initiative, to increase the pipeline of cybersecurity professionals. The scholarship is opened to full- and part-time students who are enrolled in SUTD’s MSSD programme, and students who are already midway through MSSD are eligible to apply too.

The recipients have performed distinctively well and one of them was supported under CiMS to present at the 21st International Conference on Applied Cryptography and Network Security 2023.



Fig 1: Mr Stanley Tsang (seventh from right) and Prof Jianying Zhou (fifth from right) with the CiMS recipients at the award ceremony

Critical Infrastructure Defence Exercise 2023

CIDeX is a national cyber security exercise organised by the SAF's Digital and Intelligence Service (DIS) and Cyber Security Agency of Singapore (CSA) to train critical infrastructure operators in identifying and responding to cyber attacks on the nation's critical infrastructure. More than 200 participants from over 20 organisations were involved in the three-day exercise from 22 to 24 Nov 2023 at the National University of Singapore. As the host of four physical and digital critical infrastructure testbeds and digital twin, iTrust was able to support CIDeX in using its realistic platforms to give participants "an experience of what it is like," to be in a nation-under-attack scenario," said Colonel Tan Shengyang, commander of the DIS' Cyber Defence Group.



Fig 2: ME5 Chia Bing Qiang sharing about CIDeX to the visitors (photo credit: The Straits Times)

International Collaborations

Power Trip

In Sep 2023, iTrust Assistant Director Mark Goh and Cyber Tech Lead Francisco Furtado met for the first time government agencies, industry and academia from the UK energy sector, and showcased iTrust's capabilities in the cyber protection of critical infrastructure. During the trip, iTrust established links with Ofgem, UK's independent energy regulator, Northern Powergrid, a distribution network operator for the North East England and Yorkshire regions and the North Lincolnshire area and the University of Bristol, with whom iTrust is a collaborator in the cyber security track of its Supergen Energy Networks Hub (Phase 2).

These partnerships have resulted in a follow-up trip back to the UK in Nov 2023, where Mark and Francisco were invited by University of Bristol and Ofgem to attend their respective meetings – the Impact Advisory Committee (IAC) meeting at the University of Manchester on 14 Nov 2023 and the Forum for Industry Government and University Research knowledge Exchange (FIGURE) Forum at Imperial College London on 23 Nov 2023.



Fig 3: iTrust Assistant Director Mark Goh presenting at the FIGURE Forum at Imperial College London

The IAC meeting was a gathering of consortium members to discuss and chart the research direction of the most pressing issues around cyber and net zero elements facing the UK energy landscape, with electric vehicles and the cyber security of their supporting infrastructure being a common denominator. This topic was proposed by iTrust alumni Dr Sridhar Adepu, a lecturer in Cyber Physical Systems Security at the University of Bristol.

At the FIGURE Forum, Mark introduced iTrust to many attendees for the first time, and found like-minded parties in the University of Birmingham, the National Cyber Security Centre, National Grid and Rolls Royce.

With fresh funding injected into iTrust Labs Phase 2 (see earlier article) to entrench iTrust testbeds' reputation and relevance OT cyber security, three other key focus areas during the trip were: (1) digital twins (2) maritime cyber security and (3) industrial IoT. These were explored in visits to the University of Greenwich, NATO Defence Innovation Accelerator for the North Atlantic, Delft University of Technology, Eindhoven University of Technology, IMT Atlantique, Newcastle University and Cardiff University, which were sandwiched between the IAC meeting and FIGURE Forum.

University of Greenwich

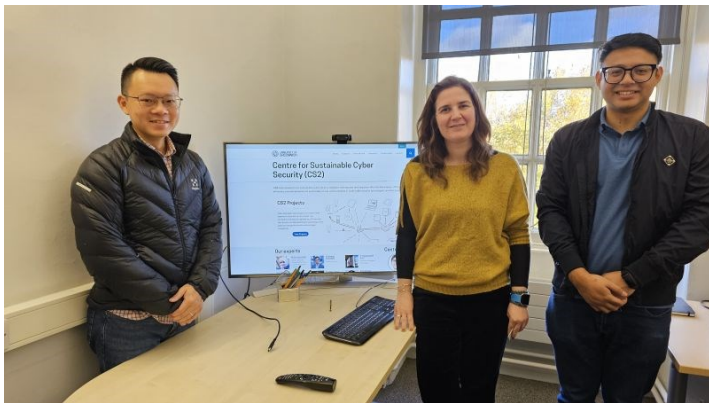


Fig 4: Mark and iTrust Cyber Tech Lead Francisco Furtado with Prof Georgia Sakellari (centre) at the University of Greenwich

A key interest of iTrust's meeting at the University of Greenwich on 15 Nov 2023 was an EU-funded project titled "Cyber security 4.0: protecting the Industrial Internet Of Things (C4IIoT)," led by Assoc Prof Georgia Sakellari. The project focused on a dynamic selection of nodes (IoT device, edge, cloud) for anomaly detection, with each node having a different complexity AI/deep learning models for the deployed anomaly detection. Prof Sakellari added that the dynamic selection/decision making hinged on "metrics such as accuracy, processing time/energy consumption of the device, as well as the condition of the network that connects them to achieve overall faster and more accurate detection." iTrust offered its OT and IoT testbeds as a platform for the deployment of these IoT devices and to realistically test the C4IIoT framework. A later discussion with Prof Francoise Sailhan (see IMT Atlantique below) also unveiled a similar research interest.

NATO Defence Innovation Accelerator for the North Atlantic (DIANA)

In its website, DIANA describes itself as providing "deep tech and dual-use innovators with access to NATO resources including grant funding, acceleration services,

and pathways to adapt their solutions for defence and security needs." Recognising ways in which iTrust could contribute to NATO DIANA's effects, iTrust met with its Chief Commercial Officer, Adrian Dan, and General Counsel, Tom Dallas McSorley, to explore how iTrust testbeds' capabilities could contribute as a resource for companies within its accelerator programme to testbed their technologies to bring it to market adoption.

Delft University of Technology (TU Delft)

Thanks to the introduction by Prof Robert Kooij from TU Delft (himself a Principal Research Scientist with iTrust from 2018 – 2019), we were able to visit its Control Room of the Future (CRoF) on 16 Nov 2023 and meet with its technical director, Asst Prof Alex Stefanov. The CRoF is built for the academia and industry to explore ways to enhance the cyber security and resilience of the electricity grid through the use of digital twins and simulations. Prof Stefanov added, "We'll be using AI to detect cyberattacks, develop defence strategies and to support the human operators working in the real control rooms." Having learnt about the CRoF's capabilities, iTrust and Prof Stefanov discussed the possibilities of interconnecting each other's digital twins and conduct joint research into the cyber resilience of electricity grid.

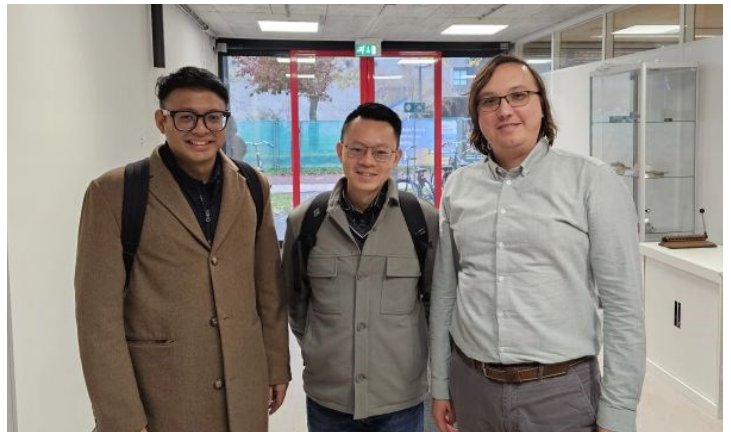


Fig 5: Mark and Francisco Furtado with Prof Alex Stefanov (right) at Delft University of Technology

Eindhoven University of Technology (TU/e)

Learning of iTrust's interest in IIoT, TNO introduced iTrust to Dr Harold Weffers from TU/e, who extended an invitation to participate in the "4th Round Table on cyber security of Internet-of-Things" organised by INTERSECT at TU/e on 17 Nov 2023. INTERSECT is a public-private-partnership funded by the Dutch National Research Council, comprising more than 40 members from universities and the public and private sectors, and focusing on R&D and technological innovation for a novel approach to the cyber security of IoT. The session was



Fig 6: Francisco sharing about iTrust with the INTERSECT consortium at Eindhoven University of Technology

attended by professionals from ICT Group, Philips, Thermo Fisher Scientific, TMC, TNO and the University of Twente. Even as the industry is grappling with security and privacy challenges in IoT devices, technology advancements mean that the OT landscape is gradually experiencing “Groundhog Day” as more IoT devices are deployed in OT environments, with the same security and privacy challenges as their IoT counterparts. Naturally, then, the discussions revolved around IoT security advancements, market challenges and regulations in the EU. In this, iTrust identified partners to work with in setting up IoT devices for security testing, as well as continuous professional training in OT cyber security.

IMT Atlantique

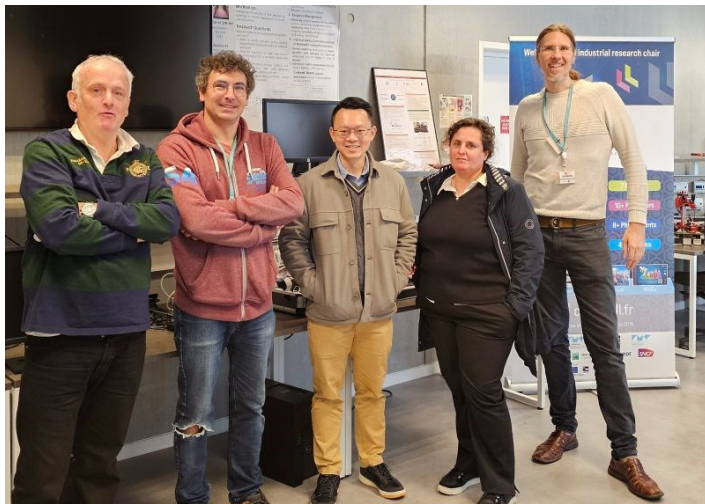


Fig 7: Mark at IMT Atlantique’s Rennes campus with (from left) Prof Yvon Kermaerrec, Research Engineer Fabien Autrel, Prof Françoise Sailhan and Prof Marc-Oliver Pahl

Relentless in establishing connections, Prof Robert Kooij linked iTrust with Prof Yvon Kermaerrec, a Professor of Computer Science at IMT Atlantique with a focus on maritime cyber security, especially in training and education. In the meeting at IMT Atlantique’s campus in Rennes on 20 Nov 2023, Prof Kermaerrec was joined by Prof Marc-Oliver Pahl and Prof Françoise Sailhan, who

have research interests in anomaly detection in OT and IoT environments.

As a start, Mark and Prof Kermaerrec both found a common interest in the development of course curriculum for maritime cyber security training and education. Mark also helped to link IMT Atlantique’s Head of International Office Eliane Fonseca with SUTD’s International Relations department to establish university-level partnerships.

Newcastle University

At Newcastle University (21 Nov 2023), Mark was hosted by another iTrust alumni, Dr Mujeeb Ahmed, a Senior Lecturer in the university’s Secure and Resilient Systems Group. Mujeeb and Mark also introduced their colleagues to each other: Dr Stephen McGough, a Senior Lecturer in Data Science and Machine Learning and Dr Gauthama Raham, iTrust’s Research Fellow in AI. Both shared their approaches to using AI for anomaly detection in OT environments and shared their latest research findings, with a common OT sector in water. Dr McGough also shared that his group is looking into the cyber defence against AI-generated attack mechanisms, which could become a trend and additional challenge as the world moves towards a more AI-enabled society.

Cardiff University

In his visit to Thales in Mar 2023 with CSA, Mark was introduced by Thales to Prof Omer Rana from Cardiff University virtually, who presented his group’s work in the cyber protection of oil and gas and autonomous vehicle sectors. It was then a pleasure to be able to meet with Prof Rana in person on 22 Nov 2023 at Cardiff University, along with his colleagues Prof Pete Burnap and Dr Vijay Kumar. A key common interest between Cardiff University and iTrust is the use of digital twins to augment cyber security research, including the federation



Fig 8: Mark’s meeting with (from left) Dr Vijay Kumar, Dr Sridhar Adepu, Prof Pete Burnap and Prof Omer Rana at Cardiff University

of the respective universities' up- and downstream digital twins to expand and enhance the digital platforms.

Visits

Tulip Season

iTrust and the Future Communications R&D Programme Office (FCP) welcomed a strong 20-plus delegation from KPN, a Dutch telecommunications company on 10 Oct 2023.

The visit was a result of SUTD's perennial ties with those who were once associated with SUTD – Prof Robert Kooij, iTrust's Principal Research Scientist (2018-2019) and Ms Denice Tuinhof, an SUTD Master's student in AI in 2020. The visitors shared three how KPN's work in secure data exchange, digital twin and quantum computing helped to better serve its clients. KPN's visit was followed a week later by another Dutch delegation, through the introduction of Dr Mark van Staalduinen, with whom iTrust collaborated in a blockchain R&D project. In both visits, iTrust's Cyber Tech Lead Francisco Furtado and FCP's deputy director Assoc Prof Binbin Chen walked the visitors through the focus areas and activities of their respective centres, and a demonstration and tour in the labs.

iTrust Matters

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