NEWSLETTER

Issue 11
February 2021

E2S2 Senior Research Fellow Dr LI Xian and Research Fellow Dr LI Wenxuan were invited to participate the Global Young Scientists Summit (GYSS 2021) in Singapore during 12-15 Jan 2021 as the representatives of E2S2 program. GYSS is a multi-disciplinary summit that covers topics including chemistry, physics, medicine, mathematics, computer science and engineering. The theme for the Summit is "Advancing Science, Creating Technologies for a Better World". Promising young scientists exchange ideas and knowledge with the speakers and their peers over four days under this theme. During the live session, Dr LI Xian and Dr LI Wenxuan presented management structure, main facilities, milestones and major achievements of E2S2 program, which were very well received by international audiences.

From https://www.nrf.gov.sg/gyss/home

Recent accepted/published papers from E2S2:

1 Designing a smart incentive-based recycling system for household recyclable waste

Journal: **Waste Management**

Authors: **Jieyu Zhou, Peng Jiang, Jin Yang, Xiao Liu**

Keywords: **Household waste recycling, Incentive-based system, Smart system design, Information sharing, Data analytics, Digitalised waste management,**

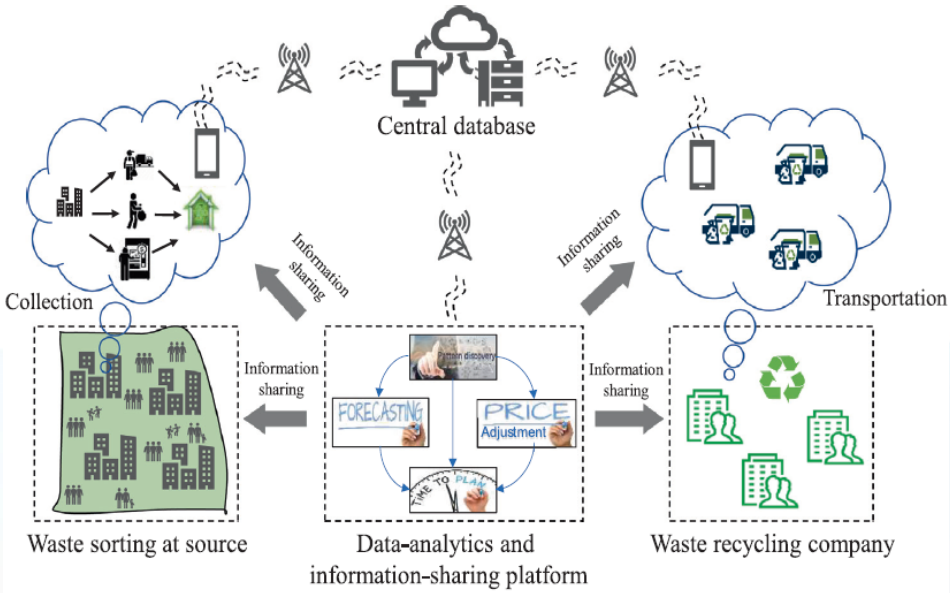

Fig. 1. Smart incentive-based recycling system for household recyclable waste.

Abstract: Household waste recycling is a significant challenge for society. Cities worldwide have been exploring how to reduce waste through recycling. Incentive mechanism is one of the promising measures to improve the participation of residents in waste recycling activities. However, several defects have been observed in the incentive-based waste recycling systems: (1) inefficient allocation of resources in recycling services, (2) deficient systems lacking future planning, and (3) limitations in circulating responsive feedback amongst stakeholders. For overcoming these defects, a smart incentive-based recycling system is designed using the Internet of Things and data analysis technologies. Four key components in the designed system—namely, amount pattern discovery, price adjustment suggestion, waste-collection amount forecasting, and information sharing amongst stakeholders—assist in constructing a smarter system to enhance waste recycling. A basic incentive-based recycling system in Shanghai, with data on 19 specific recyclable items from 21 August 2018 to 20 March 2019, was improved to demonstrate the effectiveness of the designed system. For the case of a pilot community, the recyclable waste-collection amount increased 229.3%, but the weekly pattern of collection amount got imbalanced, especially at weekends. The weekly pattern analyses suggested adjusting the pricing for cardboard, strawboard, plastic bottles, and old clothing amongst the six identified items (i.e. taking ~80.0% by weight) to balance the collection amount and allocate resources better for waste-collection operations. The two-month trend analysis and fortnight forecasting help to make plans rationally for recycling businesses. Under the new information-sharing platform, stakeholders could collaborate smoothly in household waste recycling and reduction.

Recent accepted/published papers from E2S2:

2 A feature reconstruction-based multi-task regression model for cyanobacterial distribution forecasting along the water column

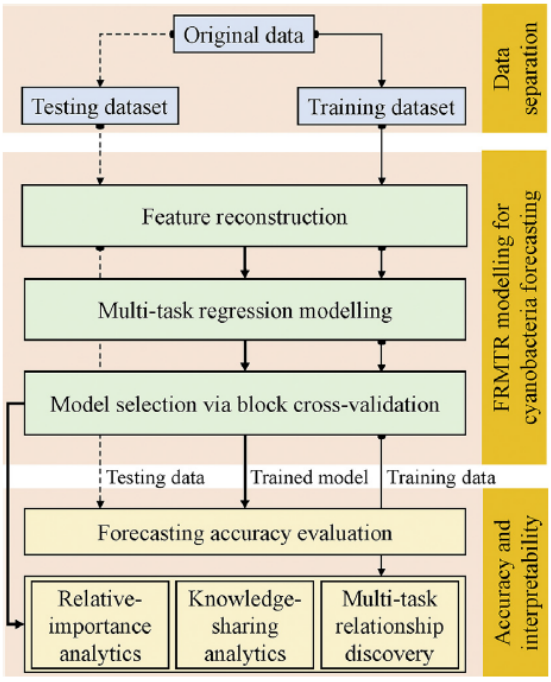

Fig. 4. Flow chart of the modelling procedure.

Journal: **Journal of Cleaner Production**

Authors: **Peng Jiang, Yibin Huang, Xiao Liu, Jingjie Zhang, Karina Yew-Hoong Gin**

Keywords: **Cyanobacterial blooms, Multiple water depths, Distribution forecasting, Model interpretability, Multi-task regression,**

Abstract: Cyanobacterial water pollution has been threatening the cleaner ecosystem and urban sustainability due to the harmfulness to aquatic ecosystems and human health, which triggers the development of an effective forecasting tool for cyanobacterial blooms. Along the water column, the variations in cyanobacteria cell densities show various distribution patterns and are influenced by multiple environmental actors. Most data-driven models treat cyanobacteria forecasting at a specific water depth as a single task, which fails to share knowledge amongst water depths, resulting in unfavourable forecasting accuracy. This is why an increasing number of nonlinear black-box models have been built for cyanobacteria forecasting but at the expense of model interpretability. This study aims to investigate whether forecasting accuracy and model interpretability can be enhanced by (i) using easily accessible predictors and (ii) developing a feature reconstruction-based multi-task regression model with knowledge sharing amongst water depths. Real-world data from a tropical lake are used to evaluate the effectiveness of the model. For the studied lake, the highest average cyanobacteria cell density occurs at 1.0 m, after which it decreases by over 30% at 5.5 m. The correlation coefficients of time-serial cyanobacteria cell densities between adjacent water depths are greater than 0.95 ($P < 0.001$). The forecasting results indicate that, compared to single-task nonlinear models, 20.59%, 16.25%, and 22.70% error reductions, measured by the mean square error, are achieved for one-day-ahead, two-day-ahead, and three-day-ahead cyanobacterial bloom forecasts. The accurate bloom and non-bloom signals under the proposed model are up to 94.81% and 98.28%. Based on the proposed model, the relative importance of predictors, the sparsity of regression coefficients, and the covariance relationship of regression coefficients can interpret the model adequately and elucidate the mechanism of knowledge sharing and forecasting accuracy improvement.

The staffs recently joined E2S2

- Dr. Yan Miao

Dr. Yan Miao is a research fellow of ECLFV. She obtained her PhD degree under supervision of Prof. Irini Angelidaki in the Environmental Engineering Department, Technical University of Denmark. During the PhD, she had an external stay in the Department of Biology, University of Padua, and Delft University of Technology. Her research focus is to develop sustainable strategy to alleviate ammonia toxicity in anaerobic digesters and decipher the microbiome and microbial metabolic pathway in digesters.

The documented expertise are in:

- Molecular techniques: 16S rRNA gene sequencing, genomics-centric analysis, polymerase chain reaction, DNA extraction, identification of targeted microbes by Confocal microscopy, microbial acclimatization, preservation etc.
- Optimizing parameters of anaerobic reactor to increase methane production.

Her current research focuses on post-treatment of digestate to generate fertilizer.

Dr Yan Miao

E2S2 Research Fellow

The staffs recently joined E2S2

- Dr. Yan Miao

SELECTED PUBLICATIONS

Yan, M., Treu, L., Campanaro, S., Tian, H., Zhu, X., Khoshnevisan, B., Tsapekos, P., Angelidaki, I. and Fotidis, I.A. (2020) Effect of ammonia on anaerobic digestion of municipal solid waste: inhibitory performance, bioaugmentation and microbiome functional reconstruction. Chemical Engineering Journal, 126159. **(IF=10.7)**

Yan, M., Fotidis, I.A., Tian, H., Khoshnevisan, B., Treu, L., Tsapekos, P. and Angelidaki, I. (2019) Acclimatization contributes to stable anaerobic digestion of organic fraction of municipal solid waste under extreme ammonia levels: focusing on microbial community dynamics. Bioresource technology 286, 121376. **(IF=7.5)**

Yan, M., Fotidis, I.A., Jéglot, A., Treu, L., Tian, H., Palomo, A., Zhu, X. and Angelidaki, I. (2020b) Long-term preserved and rapidly revived methanogenic cultures: Microbial dynamics and preservation mechanisms. Journal of Cleaner Production, 121577. **(IF=7.24)**

Yan M., Treu L, Zhu X, et al. Insights into ammonia adaptation and methanogenic precursor oxidation by genome-centric analysis[J]. Environmental Science & Technology, 2020, 54(19): 12568-12582. **(IF=7.9)**

Yan, M., Tian, H., Fotidis, I.A., Ravenni. G., Ferrigno. R., Goonesekera, M., Angelidaki, I (2020) Assessment of multiple strategies to alleviate ammonia inhibition: focusing on microbial and economic analysis (Manuscript under preparation for submission)

The staffs recently joined E2S2

- Sun Ziying

Ms Sun Ziying

E2S2 Research Engineer

Ziying Sun joined E2S2-CREATE program as Research Fellow in JAN 2021. She completed her MSc from University College London (UCL), UK in Environmental Systems Engineering. Her study focuses on quantitative sustainability assessment especially life cycle assessment for supporting the design and delivery of bioresource to energy technology and infrastructure.

In the transition towards more sustainable energy supply to attain sustainable development goals with focus on circular economy, it is necessary to explore energy recovery from bioresource especially waste to reduce dependence on conventional fossil fuel. The advancement and application of quantitative sustainability assessment with higher comprehensiveness level to include not only environmental indicators but also social and economic factors are significantly necessary to provide robust supports for the wide implementation of novel bioresource to energy technologies. Ziying believes that E2S2-CREATE can provide an outstanding platform for relevant fundamental research in improving variable sustainability assessment tools to eventually promote the penetration of bioresource to energy supply system.