

PhD studentship (Full-time)

Institution	Xi'an Jiaotong-Liverpool University, China
School	School of Advanced Technology
Supervisors	Principal supervisor: Dr Rui Yang (XJTLU) Co-supervisor: Professor Weijian Han (JITRI) Co-supervisor: Dr Li Huang (JITRI) Co-supervisor: Professor Yuyuan Zhao (UoL)
Application Deadline	Open until the position is filled
Funding Availability	Funded PhD project (world-wide students)
Project Title	基于机器学习的先进高强钢本构关系建模方法研究 The Constitutive Law Establishment of Advanced High Strength Steel based on Machine Learning
Contact	Please email r.yang@xjtlu.edu.cn (XJTLU principal supervisor's email address) or hanwj@jitri-amrd.com; hli@jitri-amrd.com (JITRI supervisors' emails) with a subject line of the PhD project title

Requirements:

The candidate should have a first class or upper second class honours Bachelor degree, or a master's degree (or equivalent qualification) majored in Materials Science, Mechanical Engineering, Applied Mathematics, Data Science, Computer Science, or related fields.

The candidate should have solid background in finite element analysis or plastic mechanics (It is a plus but not a must for applicants majored in Applied Mathematics, Data Science, or Computer Science), and basic understanding of Data Science.

Evidence of good spoken and written English is essential. The candidate should have an IELTS score of 6.5 or above, if the first language is not English. This position is open to all qualified candidates irrespective of nationality.

Degree:

The student will be awarded a PhD degree from the University of Liverpool (UK) upon successful completion of the program.

Funding:

This PhD project is a collaborative research project between XJTLU (<http://www.xjtlu.edu.cn>) in Suzhou and JITRI (Jiangsu Industrial Technology Research Institute) Yangtze Delta Region Institute of Advanced Materials in Suzhou. The student will be registered as an XJTLU PhD student but is expected to carry out the major part of his or her research at the Institute in Suzhou.

The PhD studentship is available for three years subject to satisfactory progress by the student. The award covers tuition fees for three years (currently equivalent to RMB 80,000 per annum). In addition, during the period of undertaking main research at institute in Suzhou, the PhD candidate will be provided with monthly living allowance at a standard 5000 RMB by Yangtze Delta Region Institute of Advanced Materials.

Project Description:

Advanced High strength steel sheets have been widely used in automotive body manufacturing in order to achieve lightweight. Constitutive law of the material is affected by many factors, which makes it difficult for the traditional plasticity theory to predict the complex mechanical behaviors accurately and efficiently. Machine learning algorithm, with powerful data mining ability, has become a more potential computing paradigm of material mechanical behaviors. However, machine learning models require a large amount of data for training. The difficulties in establishing the constitutive model based on machine learning are as follows: how to obtain sufficient data to characterize the mechanical properties, develop a theoretical framework of plasticity based on machine learning, proposed an universal model with physical law constrained and related training methods to achieve accurate prediction of the complex mechanical behaviors, prove equivalent robustness in FEA solvers compared to traditional physical based constitutive law.

Major research work in present project includes, (a) Conduct Experimental study on the mechanical behaviors of selected advanced metals (b) Construct machine learning based constitutive model theory with physical law constrained/motivated and deliver mathematical proof.(c) Build constitutive model (Plasticity+Fracture) based on machine learning, CAE simulation and experimental verification.(d) Implement into the FEA solver and prove robustness.

The objective of the project is to develop a machine learning framework for material modeling by introducing priori material law. The framework should be successfully applied to datasets representing several distinct classes of materials. It reproduces the three-dimensional as well as two-dimensional stress-strain responses such as damage, fracture for arbitrary loading paths accurately and replicates the state space of

conventional models. The ultimate target is to build a universal framework (or model) that is able to “teach” machine “learn” the material law effectively, accurately and reliably.

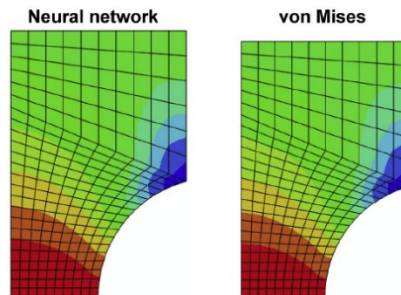


Fig. 1. An example of applications of Machine Learning based Constitutive Law in Finite Element Analysis (Neural network vs Von Mises) (Annan Zhang, 2020)

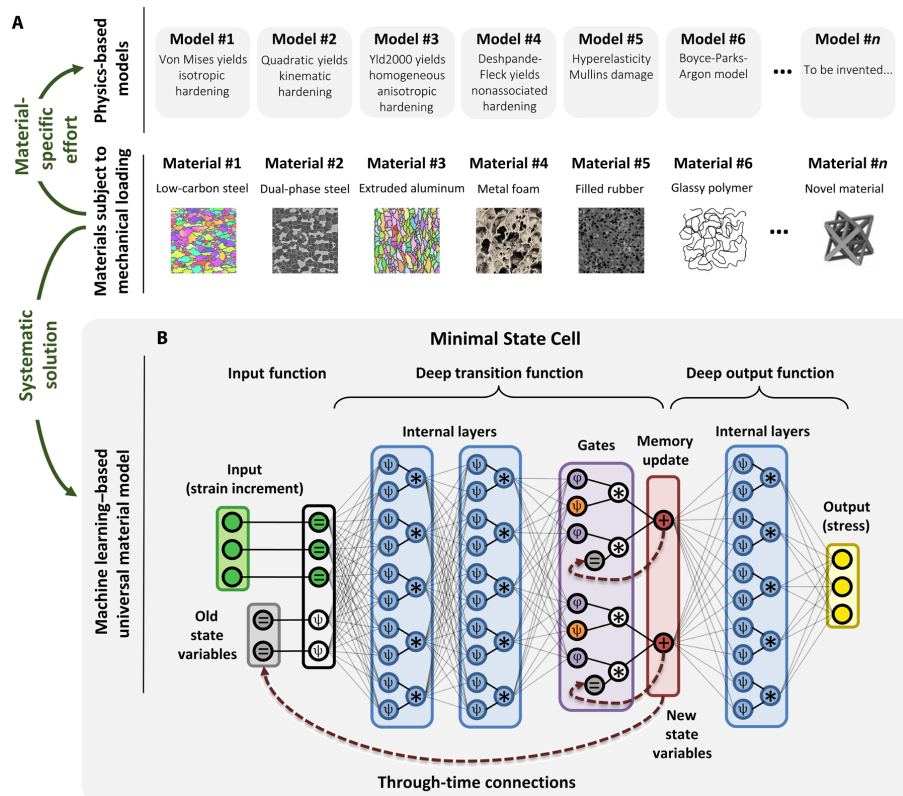


Fig. 2. An example of Machine Learning based Constitutive Law Framework (Colin Bonatti ,2021)

Provision of Training in Current Project could include, (a) Provided necessary FEA Software and Basic Data Science Training; (b) On-site Training on Experiments (c)

Support to attend External Academic Conference if needed (d) Provide opportunities to meet with Top CAE/Solver developers

For more information about doctoral scholarship and PhD programme at Xi'an Jiaotong-Liverpool University (XJTLU): Please visit

<http://www.xjtlu.edu.cn/en/study-with-us/admissions/entry-requirements>

<http://www.xjtlu.edu.cn/en/admissions/phd/feesscholarships.html>

Supervisor Profile:

Principal Supervisor:

Dr. Rui Yang received his PhD and B. Eng in Electrical and Computer Engineering from National University of Singapore in 2013 and 2008 respectively. He was an Associate Professor in Shandong University of Science and Technology from 2015 to 2019. Since 2019, he has been in Xi'an Jiaotong-Liverpool University. He is listed in Jiangsu Province Qinglan Project 2021 and Jiangsu Province High-level Innovative and Entrepreneurial Talent 2020.

JITRI co-supervisor:

Dr. Han, received his Ph.D of Mechanical Engineering in Tulsa University, served as Director of Research and Advanced Engineering for Asia Pacific at Ford before retired in 2019. He led the team to carry out more than 100 research projects in China, published 8 books and over 40 academic articles on vehicle engineering. His technical expertise includes lightweight materials, joining technologies, smart manufacturing, and environmental sciences. In 2019, Dr. Han joined the Yangtze Delta Region Institute of Advanced Materials, and served as Director, focusing on the industrial materials database/platform construction and data-driven product design tools development.

Dr. Li Huang, Research Manager and Director Assistant at Yangtze Delta Region Institute of Advanced Materials, Professor at Nanjing Tech University. He has been a Senior Research Scientist at Ford Research and Development Center, and visiting scholar at University of Michigan from 2012 to 2015. His research interests include manufacturing digitalization, integrated computational materials engineering, machine learning and its applications, big data and AI driven joining design and equipment development. His research has been successfully implemented into 10+ massively produced vehicles, including Ford Fusion and Ford F-series Truck, and significantly reduced the design cycle and cost. He received awards include "Talent in Suzhou Key

Industries”, “Ford Global Tech Achievement Award”, “Ford Global Body & Safety VCSE Tech Award”, “Ford Global Annual Top Research Achiever” etc. He has been the Key Investigator in 10+ University-Industry Joint R&D Projects, 2 National/ International Key R&D Program.

How to Apply:

Interested applicants are advised to email r.yang@xjtlu.edu.cn (XJTLU principal supervisor's email address) or hanwj@jitri-amrd.com; hli@jitri-amrd.com (JITRI supervisors' emails) the following documents for initial review and assessment (please put the project title in the subject line).

- CV
- Two reference letters with company/university letterhead
- Personal statement outlining your interest in the position
- Proof of English language proficiency (an IELTS score of 6.5 or above)
- Verified school transcripts in both Chinese and English (for international students, only the English version is required)
- Verified certificates of education qualifications in both Chinese and English (for international students, only the English version is required)
- PDF copy of Master Degree dissertation (or an equivalent writing sample) and examiners reports available