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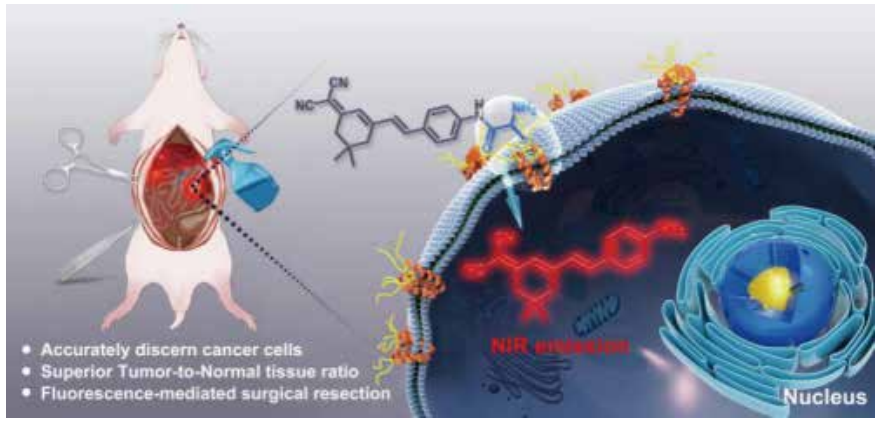
Academician Peng Xiaojun's Research Team Made Breakthroughs

Source: School of Chemical Engineering

China's dye industry is entering a new era of high-quality development characterized by structural adjustment, product upgrading and green development. As typical high value-added fine chemicals, biomedical dyes have already been used in various fields such as environmental detection, bio-labeling, disease diagnosis, as well as cancer treatment. Especially for cancer biomedicine, functional dyes play vital role in tumor diagnosis and therapeutics. Recently, the team of Academician Peng Xiaojun of State Key Laboratory of Fine Chemicals at DUT has made a series of breakthroughs in the field of fluorescence diagnosis and treatment of tumors, promoting the development of high-performance functional dyes for cancer theranostics application.

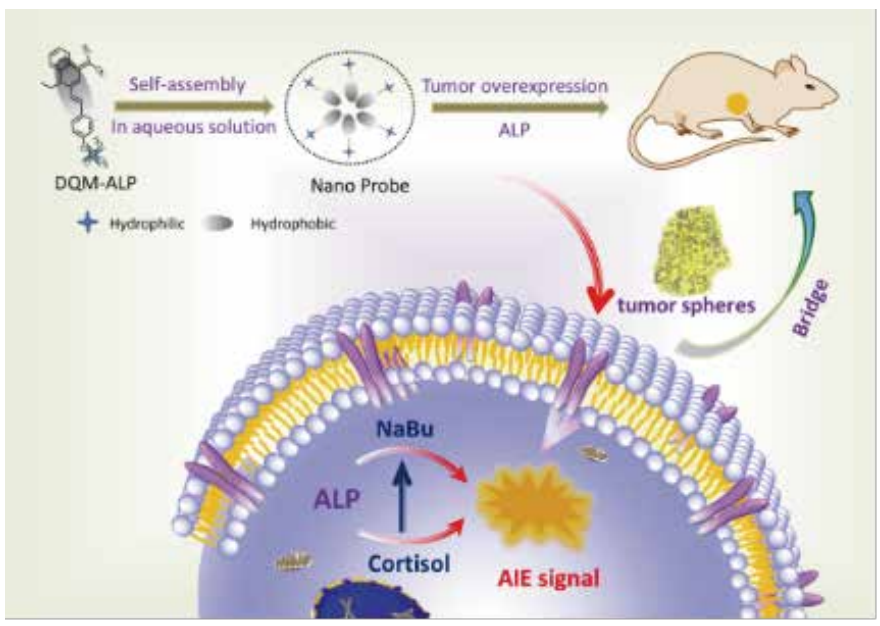
1. The recurrence of malignant tumors is mostly caused by incompleted surgical resection. Especially, it is difficult for surgeons to detect and accurately remove metastatic tumors by predominantly using visual examination and palpation owing to the lack of effective means to specifically distinguish the boundary range between normal and tumor tissues. Thus, the development of activated fluorescent probe with superior tumor-to-normal (T/N) tissue ratios is particularly urgent in clinics. In view of CD13/aminopeptidase N (APN) regarded as a cancer-specific biomarker, mediating with progression, invasion, and migration of malignant tumor, herein, we reported an APN-responsive fluorescent probe YH-APN and demonstrated its application to distinguish cancer cells. Through in situ spraying manner, fluorescent superior tumor-to-normal (T/N) tissue ratios (subcutaneous transplantation tumor, 13.86; hepatic metastasis, 4.42 and 6.25; splenic metastasis, 4.99) were achieved. More importantly, we have demonstrated the ability to image metastasis tumor tissue less than 1 mm in diameter, highlighting the potential for this probe to be used as a tool in surgical resection. This research may spur the use of enzyme-activatable fluorescent probes for the progress of tumor diagnosis and image-guided surgery (IGS).



https://pubs.acs.org/doi/10.1021/jacs.0c01365

Monitoring fluctuations in enzyme overexpression facilitates early tumor detection and excision. An AIEgen probe (DQM-ALP) for the imaging of alkaline phosphatase (ALP) activity was synthesized. The probe consists of a quinoline-malononitrile (QM) core decorated with hydrophilic phosphate groups as ALP-recognition units. The rapid liberation of DQM-OH aggregates in the presence of ALP resulted in aggregation-induced fluorescence. The up-regulation of ALP expression in tumor cells was imaged using DQM-ALP. The probe permeated into 3D

cervical and liver tumor spheroids for imaging spatially heterogeneous ALP activity with high spatial resolution on a two-photon microscopy platform, providing the fluorescence-guided recognition of sub-millimeter tumorigenesis. DQM-ALP enabled differentiation between tumor and normal tissue ex vivo and in vivo, suggesting that the probe may serve as a powerful tool to assist surgeons during tumor resection.



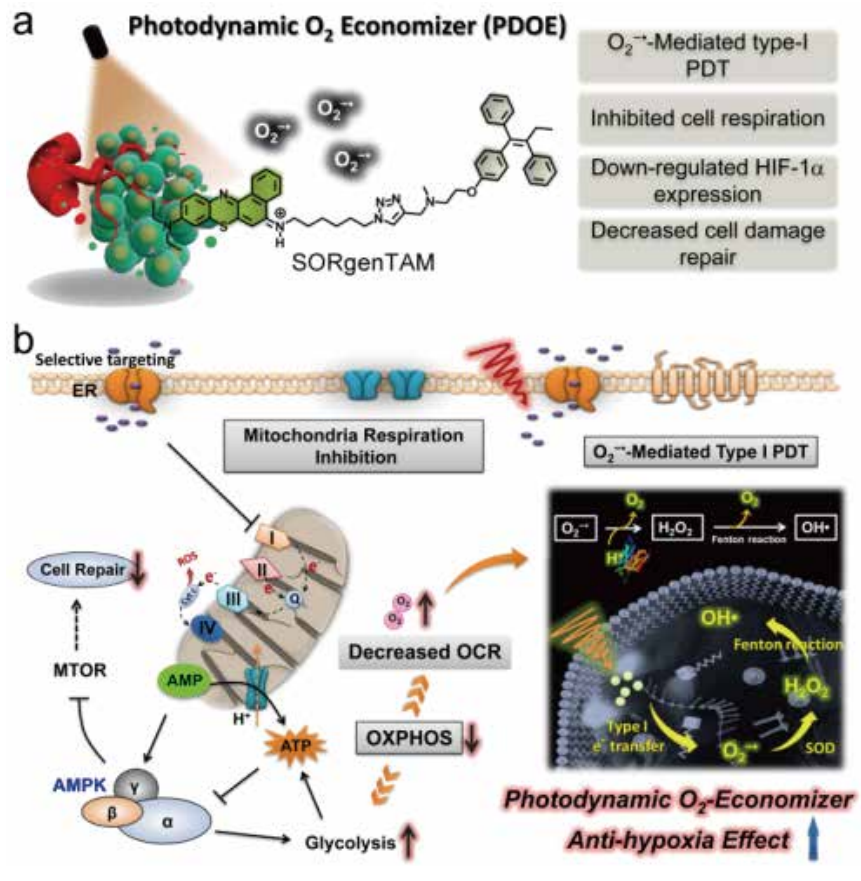
https://onlinelibrary.wiley.com/doi/10.1002/anie.202001675

This work was collaborated by the team of Academician Peng Xiaojun and the team of Academician Juyoung Yoon of Department of Chemistry and Nano Science at Ewha Womans University. The first author of the article is Li Haidong, a PhD graduate from DUT (now a postdoctoral fellow at Ewha Womans University).

2. Tumor hypoxia has proven to be the major bottleneck of photodynamic therapy (PDT) to clinical transformation. Different from traditional O_2 delivery approaches, here we describe an innovative binary photodynamic O_2-economizer (PDOE) tactic to reverse hypoxia-driven resistance by designing a superoxide radical (O_2•–) generator targeting mitochondria respiration, termed SORgenTAM. This PDOE system can block intracellular O_2 consumption and down-regulate HIF-1α expression, which successfully rescues cancer cells from becoming hypoxic and relieves the intrinsic hypoxia burden of tumors in vivo, thereby sparing sufficient endogenous O_2 for the PDT process. Photosensitization mechanism studies demonstrate that SORgenTAM has an ideal intersystem crossing rate and triplet excited state lifetime for generating O_2•– through type-I photochemistry, and the generated O_2•– can further trigger a biocascade to reduce the PDT's demand for O_2 in an O_2-recycble manner. Furthermore, SORgenTAM also serves to activate the AMPK metabolism signaling pathway to inhibit cell repair and promote cell death. Consequently, using this two-step O_2-economical strategy, under relatively low light dose irradiation, excellent therapeutic responses toward hypoxic tumors are achieved. This study offers a conceptual while practical paradigm for overcoming the pitfalls of phototherapeutics.

This work was collaborated by the team of Academician Peng Xiaojun and the team of Academician Jong Seung Kim of Department of Chemistry at Korea University. The first author of the article is Li Mingle, a PhD graduate of DUT (now a postdoctoral fellow at Korea University).

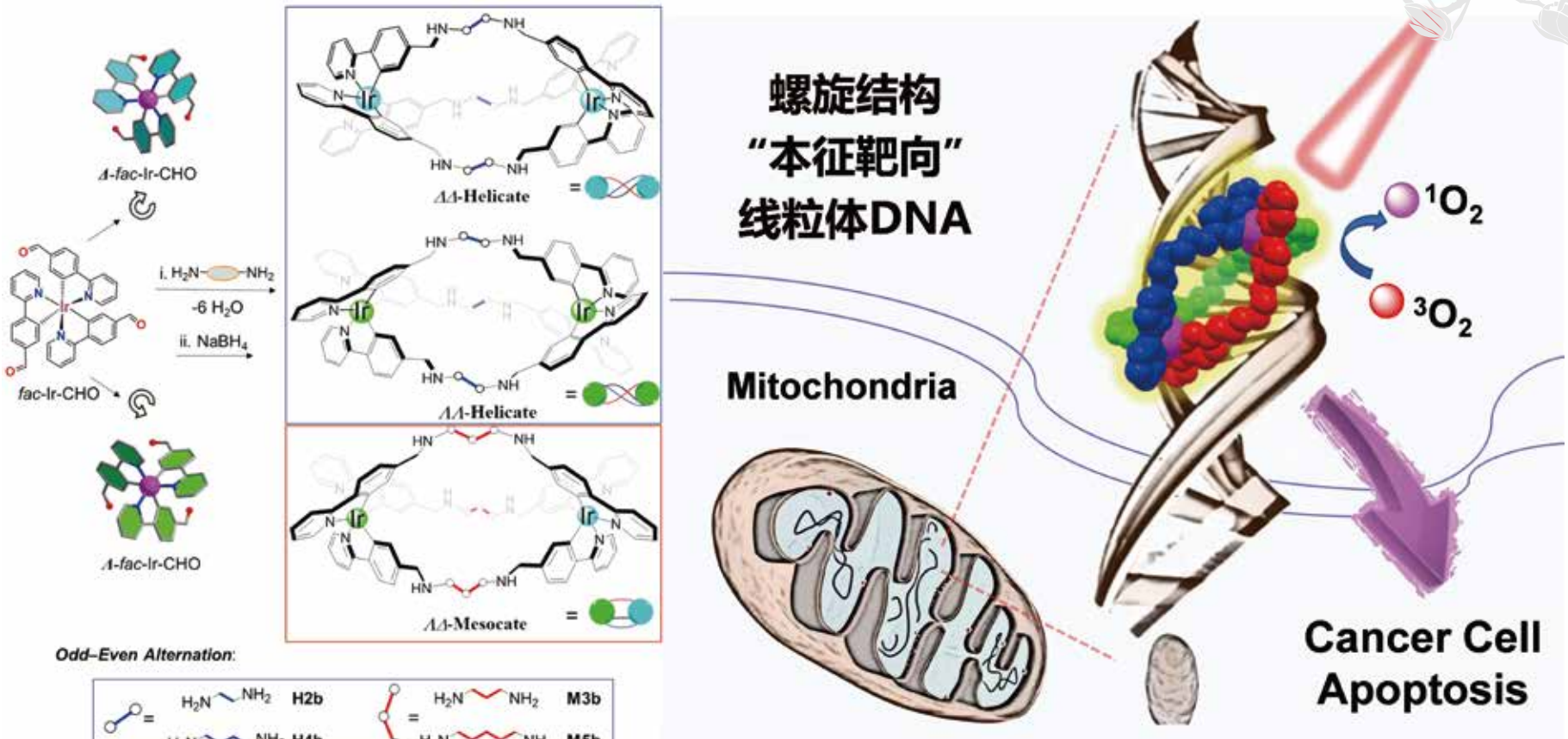
The above research is strongly supported by the National Natural Science Foundation of China, the NSFC Group Project, the NSFC-Liaoning Joint Fund, and the National Research Foundation of Korea.



https://pubs.acs.org/doi/10.1021/jacs.0c00734

DUT Made Progress in DNA-targeted PDT Agents for Cancer Therapy

Source: School of Chemical Engineering



As one of the world's deadliest disease, cancer seriously threatening human life and health. It is of great significance to explore newly accurate and effective means to treat cancer. Different from the traditional treatment approaches of chemotherapy and radiotherapy, photodynamic therapy (PDT) generally relies on the predominantly in situ generated $^1O_2$ to irreversibly damage tumors when the photosensitizers are activated by light of a specific wavelength. However, the short life-time of $^1O_2$ limits its diffusion distance in cells, which largely restricts the efficiency of PDT. The key issue includes how precisely control of the 3D geometry of the final photosensitive drugs to target biomacromolecule, such as DNA, to enhance their PDT efficacy.

Recently, Prof. Duan Chunying's research team of State Key Laboratory of Fine Chemicals at DUT made a new progress in DNA-targeted PDT agents for cancer treatment. They designed a series of dinuclear Ir^{III}-containing luminescent metallohelices that target mitochondrial DNA in cancer cells with tunable PDT efficacy.

The metallohelices were fabricated using dynamic imine-coupling chemistry between aldehyde end-capped fac-$Ir(ppy)_3$ handles and linear alkanediamine spacers, followed by reduction of the imine linkages. Interestingly, the length and odd–even character of the diamine alkyl linker determined the stereochemistry (helicates vs. mesocates). Compared to the helicates, the mesocates exhibit improved apoptosis-induction upon white-light irradiation. Molecular docking studies indicate that the mesocate with a proper length of diamine spacers shows stronger affinity for the minor groove of DNA. This study shows a promising approach for developing rational design and tailored Ir^{III}-containing luminescent metallohelices with structure-inherent DNA-targeting properties for cancer therapies, and present a platform to investigate the structure–function relationship among the metallohelices and PDT efficacy.

This research entitled *"Mitochondrial-DNA-Targeted Ir^{III}-Containing Metallohelices with Tunable Photodynamic Therapy Efficacy in Cancer Cells"* was published on the international authoritative journal *Angew. Chem. Int. Ed.,* **2020**, 59, 6420-6427 (https://onlinelibrary.wiley.com/-doi/10.1002/anie.201915281). The co-first authors of the article are Li Xuezhao, a postdoctoral fellow, and Wu Jinguo, a doctoral student. And the corresponding authors are Prof. He Cheng and Prof. Duan Chunying. This work has received strong support from the Youth Program of National Natural Science Foundation of China, NSFC-Liaoning Joint Fund Project, Sino-Dutch International Exchange Project, and Dalian University of Technology.

Prof. Zhao Nan was Invited to be the Editorial Board of IEEEWC

Source: **Faculty of Electronic Information and Electrical Engineering**

At the invitation of ***IEEE Wireless Communications***, a famous academic journal in the field of Communications, Prof. Zhao Nan of Faculty of Electronic Information and Electrical Engineering at DUT serves as the technical editorial board member of this journal. The editorial board is composed of 1 editor-in-chief, 1 deputy editor-in-chief, 9 senior consultants, 6 advisory committees, and 31 technical editorial board members, among which only 4 are from mainland China.

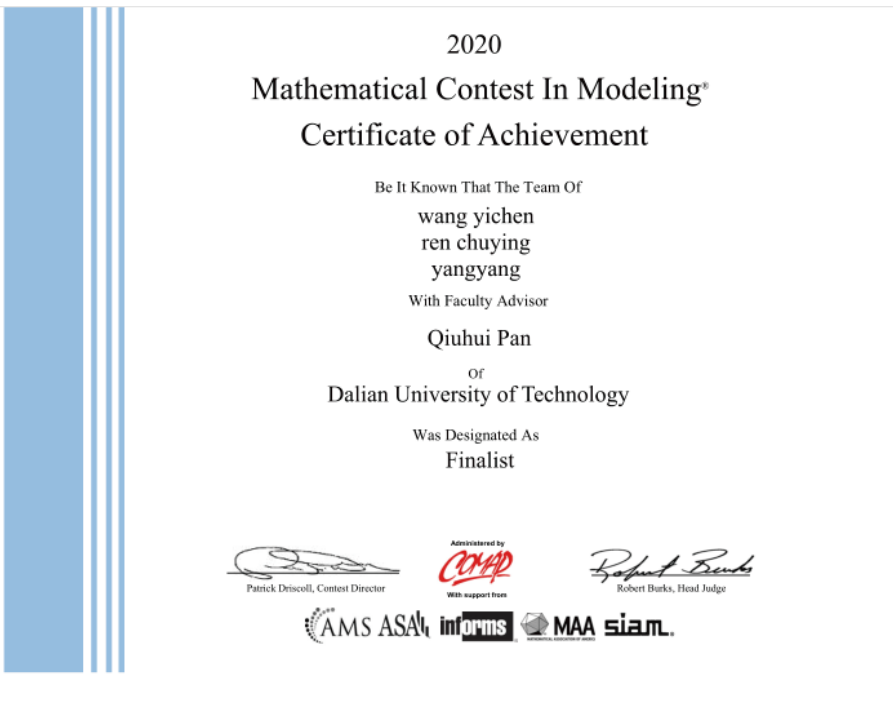
Founded in 2002, ***IEEE Wireless Communications*** (https://www.comsoc.org/publications/magazines/ieee-wireless-communications) was published by Institute of Electrical and Electronics Engineers (IEEE), which is the world's largest technical professional organization for the advancement of technology. This journal is designed for audience working in the wireless communications and networking communities. It covers technical, policy and standard issues relating to wireless communications in all media (and combinations of media), and at all protocol layers. All wireless/mobile communications, networking, computing and services will be covered. Each issue of this interdisciplinary magazine provides tutorial articles of high quality and depth concerning the revolutionary technological advances in wireless/mobile communications, networking and computing.

Prof. Zhao Nan has been engaged in teaching and research in the field of wireless communication and network for a long time, and currently serves as the editorial board member of several international academic journals such as *IEEE Transactionson Green Communications and Networking* and *IEEE wireless Communications Letters*.

Students of DLI Have Achieved Excellent Results in MCM/ICM in 2020

Source: **Leicester International Institute, DUT**

Recently, the result of the MCM/ICM (Mathematical Contest in Modeling/ Interdisciplinary Contest in Modeling) sponsored by COMAP (the Consortium for Mathematics and Its Application) was announced. More than 20,000 teams from 17 countries and regions such as China, the United Kingdom, the United States, Canada and Australia, etc, participated in the competition. Two teams consisted of Leicester International Institute, Dalian University of Technology (DLI) students, including Shenglun Zhang, Ziyue Sun, Yichen Wang, Yang Yang and Chuying Ren , won the F Prize at the same time (Top Nomination Award- 180 in total this year, with the award rate about 0.8%). They have achieved the best result of DLI in this competition, and made the historic breakthrough.


2020
Mathematical Contest In Modeling®
Certificate of Achievement
Be It Known That The Team Of
wang yichen
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With Faculty Advisor
Qiuhui Pan
Of
Dalian University of Technology
Was Designated As
Finalist
Patrick Driscoll, Contest Director
Administered by COMAP With support from
Robert Burks, Head Judge
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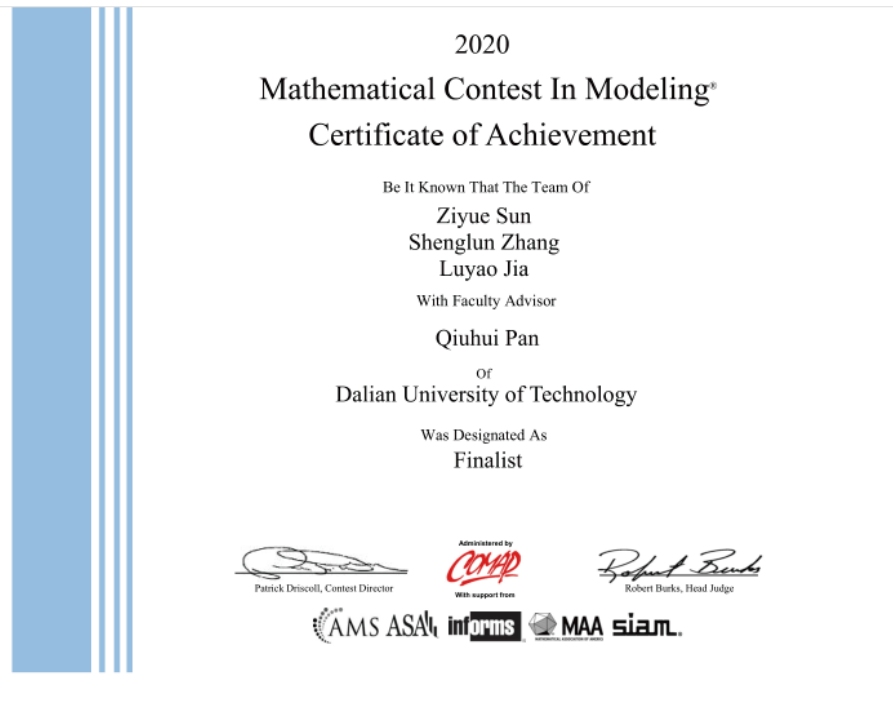
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Mathematical Contest In Modeling®
Certificate of Achievement
Be It Known That The Team Of
Ziyue Sun
Shenglun Zhang
Luyao Jia
With Faculty Advisor
Qiuhui Pan
Of
Dalian University of Technology
Was Designated As
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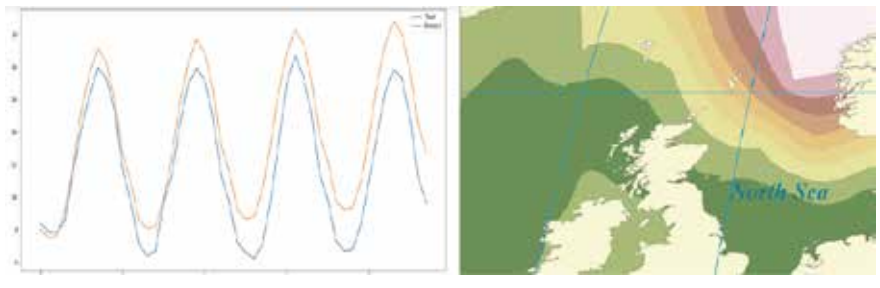
To build an “Overpass” for the integration of disciplines

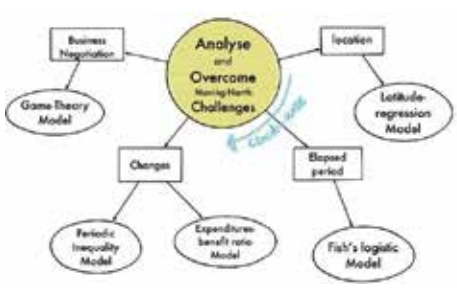
MCM focuses on examining students’ ability of the interdisciplinary application, and the application problems they investigate often rely on the knowledge literacy of multiple disciplines. Therefore, how to quickly “break the boundary of disciplines” in the competition, so as to quickly building the “overpass” of the integration of disciplines is particularly important. In this competition, both teams chose "A continuous type", which required the teams to predict the fish Moving North caused by the global ocean temperature rise, and assessed the impact of the fish migration on the business of small-scale fishing companies.

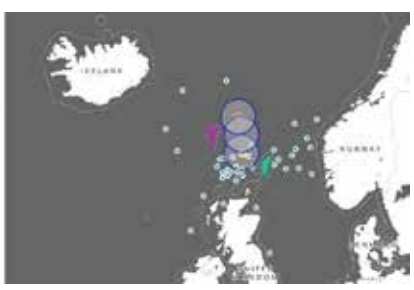
Wang team proposed the function of water temperature change in combination with the logistic growth model under the condition of fully considering the seasonal and aperiodic factors of water temperature change. The BP neural network algorithm was used to simulate and merge the function to obtain the final result. Combined with the specific situation of small fishing companies, they proposed the process of transforming fishing boats into transporting boats strategy and provided magazine articles to warn Scottish fishermen. Finally, they combined the parameters of small fishing boats to calculate the benefits

of fishing companies, and got the timetable that fishing companies need to make response when the benefits are guaranteed.



Sun team put forward a latitude regression model based on the latitude change of fish group in 50 years and a gravity center migration algorithm, and reasonably estimated the habitat of fish group after 50 years by using' Catch Per Unit Effort' (CPUE). On the basis of this model, a high-order logistic growth model was established to predict time. At last, they used the idea of revenue ratio model, periodic inequality and game theory to put forward suggestions on aspects of operation and cooperation communication from the perspective of commercial game, and analyzed the sensitivity of each model to draw the conclusion of reliability.





Innovation-driven and grasp the key of talent training

“The implementation of innovation-driven development strategy proposed by the 18th National Congress of China is to promote comprehensive innovation with scientific and technological innovation as the core.” For higher education, only by adhering to innovation driven can we tightly hold the key to talent training. Over the past three years, DLI has always attached great importance to the cultivation of students' awareness, spirit and ability of scientific and technological innovation, and has formulated a number of policies to lead scientific and technological innovation.

DLI takes advantage of science and technology salon to show cutting-edge issues, invites award-winning teams of science and technology innovation competitions to share experience, and implement "practical experience" to inject new vitality for students to participate in activities. The "Lunch with a Professional" activity is regularly carried out, which provides a platform to discuss cutting-edge scientific and technological achievements and promote academic exchanges and discussions between teachers and students by using “frontier issues” to force the innovation drive of talent training. A handbook for science innovation will be included in the gift package for new students, which introduces competition activities, event compilation.

Looking back on the past three years, DLI has made outstanding achievements in various science and technology innovation competitions. Centering on the fundamental task of cultivating talents by virtue, DLI will continue to base itself on its characteristics, inherit the spirit of DUT and rely on international vision and give full play to the radiation function of scientific and technological innovation on talent training. By consolidating the foundation, focusing on practice and innovation, DLI will promote students' ability and provide the impetus for the construction and career development of "Double-First Class".