



Transportation & Navigation

About The Hong Kong Polytechnic University – Soaring with a Vision

The Hong Kong Polytechnic University [PolyU] is the largest government-funded tertiary institution in Hong Kong, with total student numbers of more than 32,000. Through our faculties and schools – the Faculty of Applied Science and Textiles, Faculty of Business, Faculty of Construction and Environment, Faculty of Engineering, Faculty of Health and Social Sciences, Faculty of Humanities, School of Design, and School of Hotel and Tourism Management, the University **connects education and research to the real world** as manifested in our motto “To learn and to apply, for the benefit of mankind”. Our applied research and innovations have been applauded and honored worldwide for meeting the evolving needs of society and making the world we live in a better place. The University has also maintained a **close partnership with industrial and commercial sectors, and collaborated with numerous universities worldwide** in order to contribute to the society with its expertise, state-of-the-art technology and resources. All these efforts have enabled PolyU to bring about significant impacts to the development of Hong Kong, the nation and the world.

Innovation and Technology Development Office

The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong

T: (852) 3400 2806 | F: (852) 2334 8755 | E: itdo@polyu.edu.hk

W: <http://www.polyu.edu.hk/itdo/>

Copyright© 2017 by The Hong Kong Polytechnic University

Innovation and Technology Development @ PolyU

Being one of the strategic areas of development at PolyU, **knowledge transfer** has always been awarded its meed of attention and due focus from the University. It has marked numerous footprints in the University's history. PolyU has spared no efforts in sustaining its long-established eminence particularly in this area of excellence. Our **application-oriented innovation and technology development** serves to address people's needs and the community's advancement along the continuum of research through knowledge transfer to its ultimate creation of high impacts to the society. We are keen to **foster partnerships among universities, government, industry and public** at large and **minimize the gap in technology readiness** between research outcomes and society's needs.

To this end, the **Innovation and Technology Development Office [ITDO]** at PolyU is commissioned to provide and maintain an effective, sustainable **intellectual property management** system for the needs of PolyU, and to facilitate **technology development and collaborative research** to cope with PolyU's mission on innovation, application and knowledge transfer.

Transportation & Navigation Platforms @ PolyU

Steered by its pioneering vision, "Be a leading university that excels in professional education, applied research and partnership for the betterment of Hong Kong, the nation and the world", the Hong Kong Polytechnic University ("PolyU") is destined to deliver its mission "**to advance knowledge and the frontiers of technology to meet the changing needs of society**". It lays down a solid foundation initiating knowledge transfer, enlightening innovation as well as nurturing technology development from which PolyU capitalizes on sustaining its applause-winning achievements.

We pioneer advances in numerous areas and here are some of our footprints on the trail of innovation in **Transportation & Navigation**.

Transportation & Navigation

WORLD LEADER IN RAILWAY SAFETY

Hong Kong is home to one of the most well-developed railway transportation systems in the world. China also owns an extensive railway network which, along with the United States and Russia, ranks among the top three largest globally. These railways, being the most highly utilized transportation by the population, need to be continuously monitored on performance and safety.

The development of “smart railways” is a major objective not just for Hong Kong and China, but every country in the world. Detecting strains in trains undetectable by the naked eye, enhancing the precision of data measurement, processing, communication and delivery, advising on sedimentation movements which human senses would fail to detect, and last but not least, achieving all these in a cost-effective manner, will be of universal demand.

To date, PolyU experts in the Departments of Electrical Engineering, Civil and Environmental Engineering, Land Surveying and Geo-Informatics, and Building and Real Estate have contributed to the development of various new technologies in collaboration with Dalian Jiaotong University, CNR Changchun Railway Vehicle Company, and the Southwest Jiaotong University. Technologies developed are now being applied on China’s high-speed rails.



a High-speed rail

With the approval by the State Ministry of Science and Technology [MOST], PolyU established two Hong Kong Branches of Chinese National Engineering Research Centres [CNERCs] at PolyU campus; one of which is the Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Centre, which focuses on the development of advanced rail technologies to enhance the safety, reliability and comfort of the nation’s high speed rail. The comprehensive, in-depth research and technology development on monitoring, analysis, and assessment of high-speed rail is being carried out.

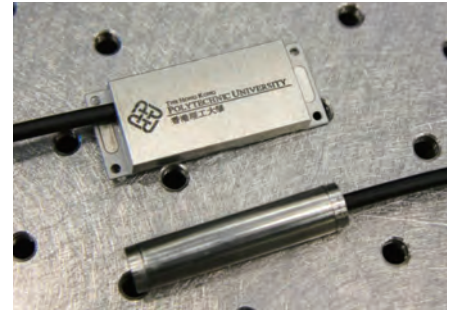


Revolutions in sensor and data processing technologies brought about by PolyU engineering and computing experts have found its way into land and sea transportations in Hong Kong and China, which have been housing some of the world’s busiest ports and most developed transportation networks. Advances in the surveillance of transportation structures, vehicle activities and their interactions with each other and the ever-changing environment ensure the efficiency and safety of our travel, every step of the way.

b Advanced Fibre Bragg Grating Railway Monitoring System and Smart “Damping” Technology

Advanced Fibre Bragg Grating Railway Monitoring System – Optical sensors which are small, light, highly sensitive, and not affected by electromagnetic interference are designed to monitor the structural health and safety of the nation’s fast-expanding High-Speed Rail. A 1cm-long strand of optical fiber with a radius of about 0.1mm is subjected to special ultraviolet rays, changing its refractive index and turning it into a Fibre Bragg Grating [FBG] sensor. Data can be collected from several hundred FBG sensors along each strand. By incorporating a series of FBG sensors along railway tracks and coaches, the system will be able to collect and analyze data in real-time to monitor the functioning of trains and tracks.

Smart “Damping” Technology – For enhancing the stability of high-speed trains, adjustable and controllable damping properties in real-time when magnetic field is applied, making the dampers especially competent when trains run at high-speeds. Safety and stability are significantly enhanced at both track and train levels. With the development of optical fibre sensors, sensor interrogation and optical sensing systems for condition monitoring, PolyU supported Hong Kong railway to install world’s first city-wide sensing networking for railway condition monitoring in 5 urban lines. In 2016-2019, PolyU is working to transfer the photonic sensing network technology to monitor conditions of Australia’s first 38-km driverless rail link.



Fiber Bragg Grating Sensor



c Intelligent Ship-bridge Anti-collision Surveillance System

An automatic identification system and a smart vision-based monitoring technology are incorporated into bridges' security for surveillance. This functions as a “black box” of the bridge to provide active monitoring and full record on marine traffic near bridges and any potential threats impacting bridge structures. Warning signals to ships, alerts to vehicles and personnel on bridges are available. Novel piezoelectric sensors are embedded in the bridge for impact-force monitoring and collision damage evaluation.

d Real-time Monitoring of Truck Loading

Automatic truck loading monitoring system integrates smart sensors, mobile communication and global positioning technologies, for smart logistics management and road safety control. This system is capable of fast truck-status checking, weight recording, loading data transmission, tracking and monitoring, position localization, logistics scheduling, a user interface, security control and emergence management.



Smart sensors used in monitoring truck loading

e Formulating New Models for Transport Service Industry

Novel optimization and econometric models with new analytical techniques and solution methods were formulated, so as to respond to the newly identified shippers' issues, during the procurement of transport services from carriers, such as value discounts, seasonality, volume commitment, firm expansion and market concentration.

f Multimedia Signal Processing (real-time driver Assisting system and Collision Avoidance system for the Mass Transit Railway Corporation [MTRC])

A real-time driver assisting system allows automatic detection of distance between cars; and distance between lane and road signs in real time. It can also be further supporting the development of driverless cars.

With the development of video object recognition and tracking technology, a system design for image sensing collision avoidance system on light-rail trains was developed for driver assistant and recording, especially in the application of safety warning.

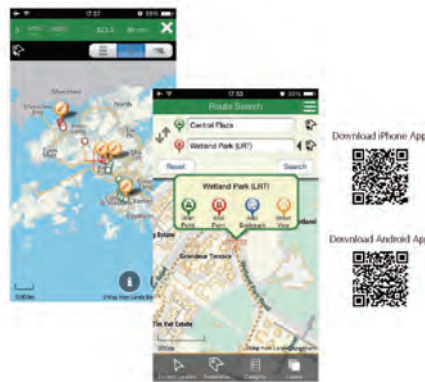
g Geographic Information System

Intelligent Transportation Systems [ITS] – PolyU has been developing and applying a number of ITS for applications, and has also been assisting the HKSAR Government to develop real-time ITS, including Hong Kong eTransport, and Public transport enquiry system. These systems are capable to provide users with information about average journey times and traffic speeds. The PolyU is extending the novel ITS by covering the public transportation network, as well as developing a people-oriented urban traffic control system, so as to assist transport management authorities in assessing the multi-modal transport network reliability, and establishing appropriate transportation strategies.

PolyU x Transport Department, HKSAR

Mobile Application

Mobile apps of HKeTransport have also been developed for iPhone and Android Phones



Kiosk

Public and tourists who do not have access to the internet or mobile data can now also enjoy the service through the "Hong Kong eTransprotKiosk".

The 6 pilot installations are at:

- Airport Terminal I
- HKCEC
- You Lai Arcade
- Tsim Sha Tsui Ferry Pier
- Sha Tin MTR Station
- Tuen Mun Road Bus-Bus
- Interchange



Global Navigation Satellite Systems [GNSS] – GNSS Reflection investigates the relationship between the physical parameters of the reflective surface and the reflected signal, in which the physical parameters can be calculated inversely from the received signal. GNSS provides users with high precision Positioning, Navigation, Velocity and Timing [PNavT] information everywhere on the Earth and even in the space. With elimination of ionospheric and atmospheric effects and ambiguity resolution techniques, a real-time kinematic long baseline GNSS centimeter-level precision positioning was achieved. Currently, the achieved accuracy of 700 kilometers baseline positioning in 10 minutes is 2 centimeters.

Moreover, with WI-FI RSSI, indoor GNSS positioning system is conducted by receiving GNSS signal after separation and via indoor signal transmission. With the use of mobile phone GNSS clip, a meter-level accuracy of indoor positioning is achieved.

Indoor Positioning System and Location based services [LBS] - Ubiquitous positioning is required in the application of LBS, so as to provide continuous positional information in both indoor and outdoor environments. A Wi-Fi positioning algorithm based on neural network modeling of Wi-Fi signal patterns is used in indoor positioning to search for the best possible nonlinear highly complex Wi-Fi signal power propagation surface. The system significantly achieved the highest possible accuracy of the Wi-Fi fingerprinting positioning method. It can be used to monitor labors, vehicles or materials of construction locations.

h Intelligent transportation system (urban traffic and transportation information system)

By utilizing different types of real-time traffic data collection technologies, PolyU assisted the HKSAR Government to develop a series of real-time intelligent transportation systems, as well as journey time indicators. These include the "Real-time Traffic Information System", "Hong Kong eRouting", "Hong Kong eTransport", "Journey Time Indication System", and "Speed Map Panels". These systems are deployed on the Hong Kong Transport Department's website.

Novel intelligent transportation system for personalized reliable driving routes

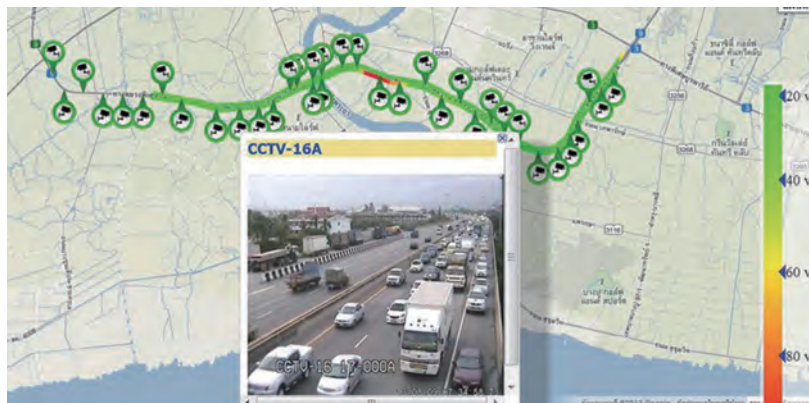
A novel intelligent transportation system has been created to help motorists identify a personalized reliable driving route, with the development of an integrated algorithm for real-time journey time estimation. This system integrates and optimizes traffic data including offline travel time forecasts; filtered real-time automatic vehicle identification data; and real-time video detector data. This helps to provide further information to traveler at a destination, such as traffic network uncertainty.



Novel Intelligent Transportation System

Predictive mathematical modelling devised at PolyU supports the development of real-time, intelligent traffic management systems

A Stochastic Cell Transmission Model [SCTM], a predictive mathematic model that works for creating real-time, and intelligent traffic management systems. This Model helps highway managers to predict traffic conditions and prevent congestion. This allows the analysis of minor events that lead to major delays, and thus modelling traffic flow density on freeway segments with stochastic demand and supply. It has been used by the Thai Expressway Authority to improve road traffic in Bangkok.



Intelligent traffic system monitors real-time data for traffic prediction

Our Aviation & Aerospace, Transportation & Navigation - related Faculties and Departments

At PolyU, we embrace collaborative research and development during our innovation process. Whatever your unmet needs are, we have a team of experts ready to help you tackle your challenges.



Faculty of Applied Science and Textiles

Department of Applied Physics

- Nanomaterials
- Photonic Materials and Devices
- Smart Materials and Devices
- Theoretical and Computational Physics

Department of Applied Mathematics

- Applied Optimization and Operations Research
- Applied Statistics and Financial Mathematics
- Engineering and Computational Mathematics

Faculty of Construction and Environment

Department of Civil and Structural Engineering

- Transportation

Department of Civil and Environmental Engineering

- Urban Hazards Mitigation
- Transportation

Department of Land Surveying and Geo-Informatics

- Surveying, Navigation and Positioning
- Geodesy and Geodynamics
- Photogrammetry and Remote Sensing
- Geographic Information Systems
- Digital Cartography

Faculty of Engineering

Department of Computing

- Big Data Analytics and Information Retrieval
- Graphics, Visualization and Multimedia
- Networking and Mobile Computing
- Pattern Recognition and Machine Intelligence
- Systems and Software Engineering

Department of Electrical Engineering

- Photonics & Smart Materials and Devices Technologies
- Railway Engineering
- Power & Energy Systems
- Power Electronics and Utilization

Department of Electronic and Information Engineering

- Communications Research
- Signal Processing
- Thin Film and Optoelectronics
- Intelligent Control and Computing

Department of Industrial and Systems Engineering

- Advanced Materials Processing
- Advanced Optics Manufacturing
- Products Design and Miniaturization
- Logistics Engineering

Department of Mechanical Engineering

- Aerospace Engineering and Aviation
- Sound and Vibration
- Fluid-Structure Interactions

Interdisciplinary Division of Aeronautical and Aviation Engineering

- Aircraft services engineering
- Aviation information systems
- Aircraft component design and manufacture
- Air transportation



Aviation & Aerospace, Transportation & Navigation - related Research Institutes & Centres

- Aviation Services Research Centre
- Consortium for Aerospace Engineering and Aviation Research
- Consortium for Sound and Vibration Research
- Hong Kong Branch of National Rail Transit Electrification and Automation Engineering Technology Research Centre
- Research Centre for Fluid-Structure Interactions
- Smart Railway Research Laboratory

The Industrial Centre ... Multi-disciplinary expertise and technologies under one roof

The Industrial Centre [IC] of PolyU is the training centre for professional engineers, as well as a one-stop technical solution provider during the innovative process. IC has a large range of technical experts who possess real industrial application experience and knowledge, who are capable of integrating PolyU's multi-disciplinary innovations with the best technical advice and solution for our partners - turning your innovative concepts and ideas into workable industrial design or even real products and systems to meet your special needs.