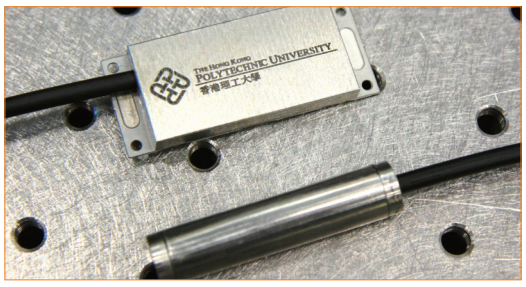
THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

精密鐵路監測系統
Advanced Railway Monitoring System

監測鐵路狀況的先進光纖光柵系統
An advanced Fiber Bragg Gratings (FBGs) sensing systems for railway condition-monitoring

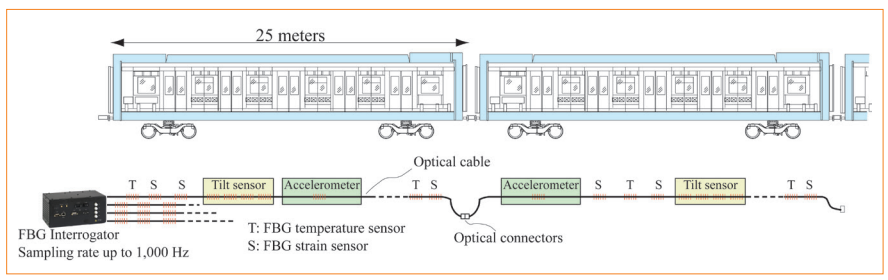
理大研發的光纖光柵鐵路監測系統，利用單一光纖光纜可在100公里的距離進行長距、實時、多點、多功能監測。與傳統技術相比，數以百計的光纖光柵傳感器可安裝於單一光纖光纜，無需鋪設複雜的電線，以便進行即時維修、大大減低鐵路的保養成本和縮短停工期。

安裝在路軌和列車上的光纖光柵傳感器會組成「光學感應神經系統」，當列車行駛時，傳感器能感測波長訊號的改變，準確地指示出非常規震動、車輪或車軸損壞及其他故障的位置，避免出軌等意外發生。此外，收集到的數據會傳送到電腦作進一步分析，為工程師提供鐵路健康的實時資料，帶來更加安全、可靠和高效率的鐵路網絡。



光纖光柵傳感器
Fiber Bragg Grating Sensor

鐵路監測系統電腦端畫面
Railway monitoring system on computer screen



運用單一探測器監察多項光纖光柵參數
Set-up of many FBGs for measuring different parameters of a train connected with a single sensor system with one FBG interrogator

PolyU has developed an Advanced Railway Monitoring System which uses the FBGs optical technology for sensing multiple points with a single optical fiber that can span 100km, realizes long-distance, real-time and multifunctional sensing. This advanced technology embeds hundreds of these micro sensors onto one single continuous optical fiber to provide just-in-time maintenance, and reduce the cost of maintenance and service downtime, as compared to conventional system which requires complex wiring.

By incorporating literally thousands of FBG sensors along railway tracks and trains, the system will have its own network of "optical sensory nerves". Whenever the train wheels pass over rail locations fitted with FBG sensors, these advanced sensors will detect any shift in the wavelength signals, pinpointing large vibration locations, derailment risk or wheel/bearing failure on the train, or any other defects. The collected data can be analyzed continually on computers online, giving engineers immediate knowledge of the "health status" of both the train and tracks. The precision of the system enables a safer, more reliable and efficient railway network.

Principal Investigators
Prof. Siu-lau HO, Prof. Hwa-yaw TAM, Prof. Siu-wing OR
Department of Electrical Engineering
Contact Details
Institute for Entrepreneurship
Tel: (852) 3400 2929 Fax: (852) 2333 2410 Email: pdadmin@polyu.edu.hk

Access More info via mobile
Note: Subject to data charges by mobile operators

專利申請編號及國家：6,208,787 (美國), 6,396,855 (美國)

特色與優點

- 抵禦電磁干擾
- 小型輕巧
- 適用於高危和易燃環境
- 佈線簡易及可多路傳輸
- 多功能:單一系統能測量多項數據
- 能提供波長編碼信息，及自我參照能力
- 反射傳感器兼具內在的後備連接可行性，從而提高系統的可靠性

應　用

- 測量及確應列車和路軌的不尋常震動、量度主要元件溫度，避免出軌，以確保鐵路服務安全、準時，並發出預警
- 此技術已應用於港鐵多條綫、京滬高鐵，以及台灣和印度的鐵路上

獎　項

- 德國Berthold Leibinger Innovationspreis應用激光科技國際獎第三獎 (2014年9月)
- 中國國際工業博覽會中國高校展區優秀展品獎二等獎(2010年11月)
- 中國國際工業博覽會金獎(2009年11月)
- 第三十七屆日內瓦國際發明及創新技術與產品展覽金獎、特別大獎 (2009年4月)
- 第五屆中國國際發明展覽會銅獎 (2004年9月)
- 第三十二屆日內瓦國際發明及創新技術與產品展覽金獎 (2004年4月)
- 2000香港國際發明展覽會金獎 (2000年11月)

Patent Application No: 6,208,787 (US), 6,396,855 (US)

Special Features and Advantages

- Immune to EMI interference and non-corrosive
- Small size, light weight
- Safe to use in hazardous and flammable environment
- Simple cabling and capable of multiplexing
- Multifunctional – one system measure different types of measurands
- Wavelength-encoded sensing information, giving referencing capability
- Reflective sensors that provide inherent redundancy and thus enhance system reliability

Applications

- Measure and identify unacceptably high vibrations in rail tracks and trains, axle counting, temperature variations of various critical components of train wagons to ensure proper operations, prevent derailments and consequently provide alert of problems affecting train service, travel times and safety
- This system is applied on several rail lines in Hong Kong, the Beijing-Shanghai High-Speed Rail, and Taiwan and India rails

Awards

- Third Prize, The Berthold Leibinger Innovationspreis (Sep 2014)
- University Pavilion Outstanding Product Award (2nd class), China International Industry Fair (Nov 2010)
- Gold Prize, 12th China International Industry Fair (Nov 2009)
- Gold Medal, 37th International Exhibition Inventions New Techniques and Products Geneva (Apr 2009)
- Special Prize of the Technological University Malek-Ashtar - I.R. Iran (Apr 2009)
- Bronze Award, 5th China International Exhibition of Inventions (Sep 2004)
- Gold Medal, 32nd International Exhibition Inventions New Techniques and Products Geneva (Apr 2004)
- Gold Award, Hong Kong International Invention Expo 2000 (Nov 2000)

1_EE_02_1117