# 大型結構診斷與預測系統
Mega-structure Diagnostic & Prognostic System

大型結構全壽命期健康監測—即時、高效、可靠
Life-cycle Health Monitoring of Massive Infrastructure – Rapid, Real-time, Reliable

應用已申請專利的技術：11/185026(美國), 200610106147.4(中國), 2008-521774 (日本), 7003984/2008 (韓國), 7,266,260 (美國), 7,206,259 (美國), 7,062,973 (美國), 6,396,855 (美國), 6,208,787 (美國)

大型結構如大跨度橋樑、高聳建築等是重要的基礎設施。維持它們安全可靠的日常運營對於保證人民的生命安全、保護人民的巨額投資和持續經濟的發展活力至關重要。然而，大型結構無法歷久彌新，它們甚至在建造當時即已開始退化。因此，診斷與預測大型結構全壽命期的安全具有極為重要的意義。

理大已經設計發明了一套大型結構診斷與預測系統，可以為大型結構提供全壽命期的安全掃描。它不僅可以盡早發現結構損傷以避免災難性的結構破壞，它還可以在災難性事故發生後的第一時間評估結構安全。它不僅告訴業主和管理者最嚴重的損傷是什麼、在哪裡、何時維修、如何維修，它還告訴業主和管理者是否需要立即疏散結構內的人員和撤離設施。
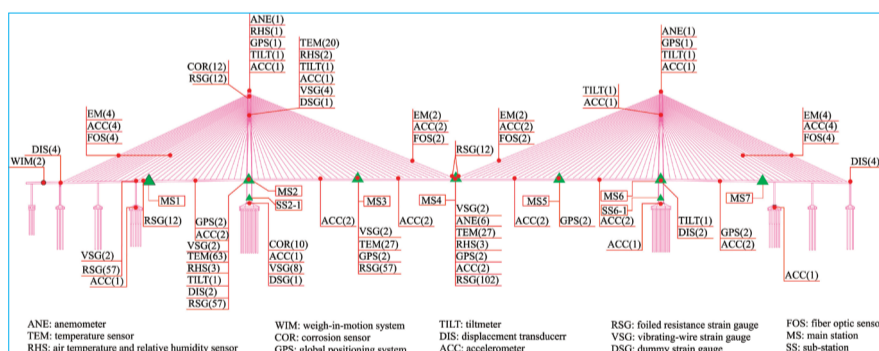

模塊化的系統結構
Modular Architecture of the System
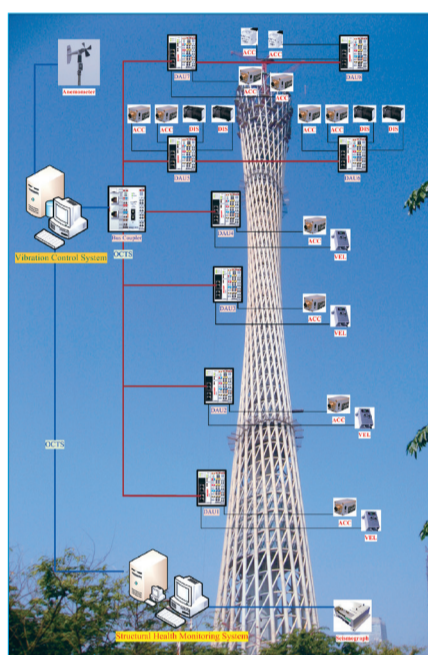
廣州塔傳感器及數據採集單元佈置
Sensors and Data Acquisition Units Deployed on Canton Tower

某船撞後的橋梁
A Destroyed Bridge after a Ship Collision Accident

蘇通大橋傳感器及數據採集單元佈置
Sensors and Data Acquisition Units Deployed on STB

Mega-structures such as long-span bridges and high-rise structures are vital civil infrastructure. Maintaining their safe and reliable operation is critical to secure the well being of people, to protect the vast investments, and to support the vitality of economy. However, mega-structures cannot last forever; they even begin to deteriorate once they are built. Therefore, it is of paramount importance to diagnose and prognose the safety of mega-structures throughout their whole life-cycle.

PolyU has devised a comprehensive diagnostic and prognostic system to provide a life-cycle screening for mega-structure's safety. Not only can it identify the structural damage at the earliest possible stage to avoid any catastrophic structural failure, but also can assess structural health immediately after any major hazardous event; Not only does it inform us what/where the severest damage is and when/how rehabilitation should be processed, but also tells us whether immediate evacuation of the occupants/contents is necessary.

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特色與優點

- 一體化的施工監控與運營監測，實現結構全壽命期健康監測
- 一體化的健康監測與振動控制，實現在線狀態監測與實時反饋控制雙重功能
- 模塊化的系統結構，便於系統維護和升級
- 新型傳感器及其定制化設計，針對特殊應用場合
- 相輔相成的有線和無線數據傳輸技術，應對施工現場的有限作業條件
- 友好的圖形用戶界面，便於系統操作
- 結構健康評價新方法，面向結構維護與管理
- 全方位的系統保護，應對惡劣的周圍環境
- 基於互聯網的數據共享與合作，實現遠程專家服務
- 旅遊觀光與科學知識普及巧妙結合，實現寓教於樂

應用

大型結構診斷與預測系統主要應用於大跨度橋梁、摩天大樓/高聳結構、隧道、大壩、鐵路和礦場等。特別地，我們已經為世界最高電視塔—廣州塔，世界最大主跨跨徑斜拉橋—蘇通大橋以及深圳証券交易所營運中心開發了結構診斷與預測系統。

獎項

- 第三十七屆瑞士日內瓦國際發明及創新技術與產品展覽 - 金獎 (2009年4月)
- 伊朗大學特別大獎 (2009年4月)
- 中國國際工業博覽會金獎 (2009年11月)

Patented technologies adopted in the system: 11/185026(USA), 200610106147.4(China), 2008-521774 (Japan), 7003984/2008 (Korea), 7,266,260 (US), 7,206,259 (US), 7,062,973 (US), 6,396,855 (US), 6,208,787 (US)

Special Features and Advantages

- In-construction and in-service monitoring combo for life-cycle health track
- Health monitoring and vibration control combo for on-line health monitoring and real-time feedback control
- Modular system architecture for easy maintenance and upgrade
- Novel sensors and tailored design customized for special circumstances
- Hybrid wired and wireless data transmission technology customized for harsh operational conditions
- User-friendly graphical user interface (GUI) for easy operation
- Innovative structural health evaluation methodologies beneficial for structural maintenance and management
- All-round protection customized for severe surrounding environment
- Web-based data collaboration for remote expert service
- Edutainment catering for sightseeing and science popularization

Application

The system is applied in long-span bridges, skyscrapers/high-rise structures, tunnels, dams, railways, and mines. In particular, we have developed the system for the world's highest TV tower – Canton Tower, the world's longest main span cable-stayed bridge – Sutong Bridge (STB), as well as Shenzhen Stock Exchange's new headquarter.

Awards

- Gold Award - 37th International Exhibition of Inventions, New Techniques and Products, Geneva (April 2009)
- Prize of the Technological University Malek-Ashtar - I.R. Iran (April 2009)
- Golden Prize - China International Industry Fair (November 2009)