

*Vessel-based Mobile Mapping System
(V-MMS) –
An application using Hong Kong
Satellite Positioning Reference
Station (SatRef) Data*

船載移動測繪系統 –
香港衛星定位參考站數據的應用



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Contents 內容

- The System 船載移動測繪系統
- System Architecture 系統結構
- SatRef Data application
香港衛星定位參考站數據的應用
 - *Real-time* 實時
 - *Post Processing* 後處理
- Problems 問題
- Applications 應用



Vessel-based Mobile Mapping System

船載移動測繪系統

Performance of point cloud:
Horizontal: 91mm(2 σ)

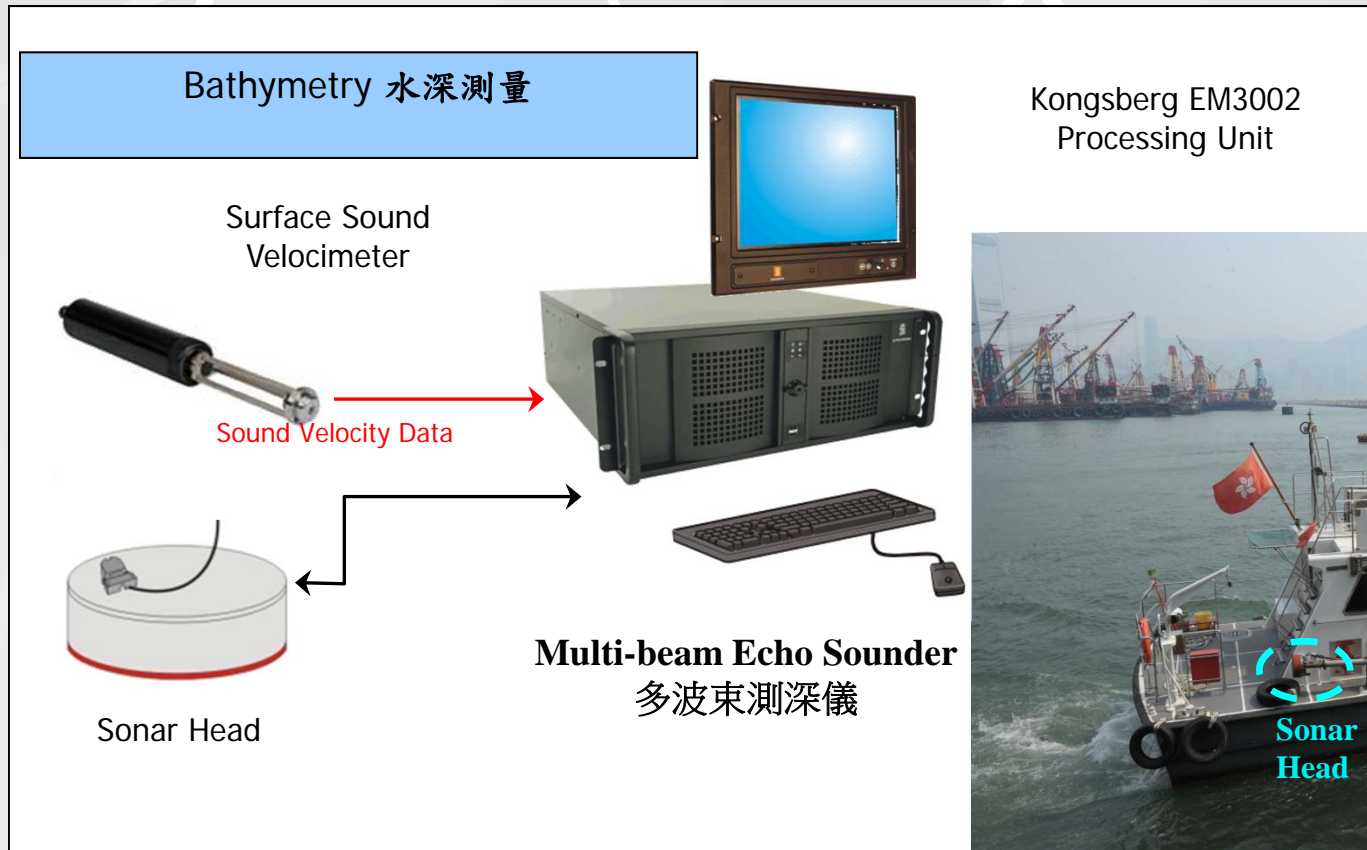
40 deg

130 deg

Sounding requirement :
Horizontal : 1.5m
Vertical : 0.25m~0.35m

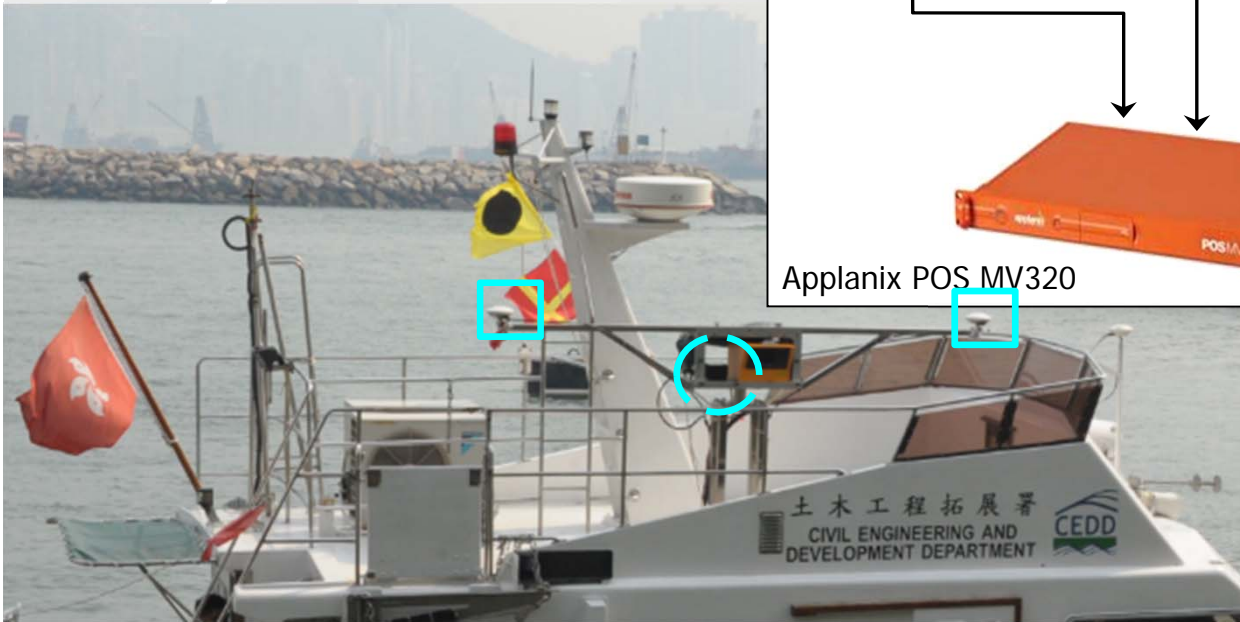
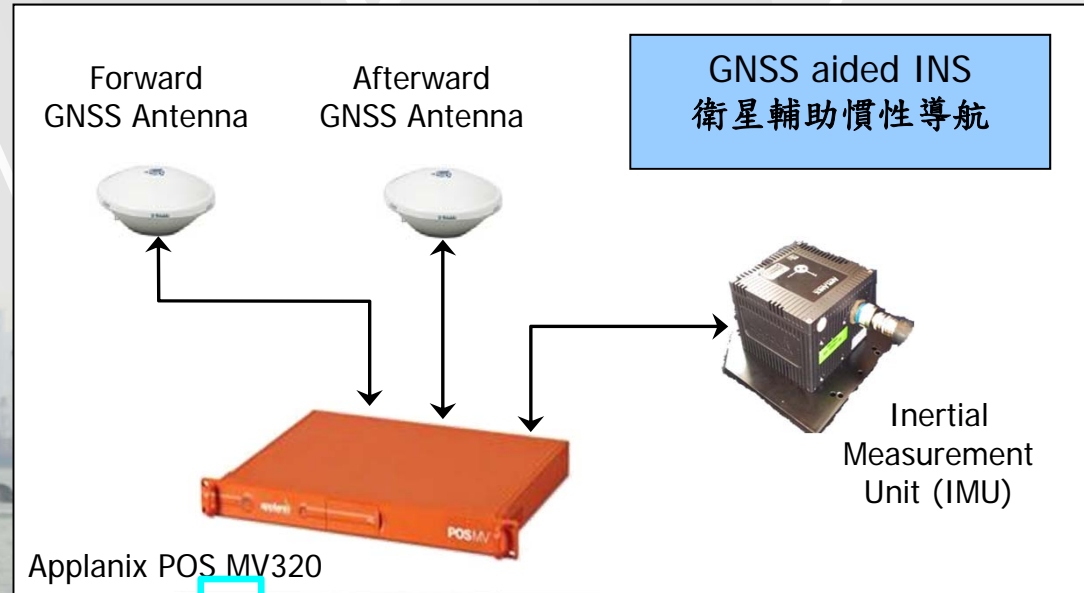


System Architecture 系統結構





System Architecture 系統結構



- Position Data 定位數據
 - *Sounder* 測深儀
 - *Laser Scanner* 激光掃描
 - *Navigation* 導航



System Architecture 系統結構



Landmark Marine
Laser Scanner

Laser Scanning 激光掃描



System Architecture 系統結構

- Navigation 導航
- Collect Data 收集數據
 - *Sounder* 測深儀
 - *Laser Scanner* 激光掃描
 - *GNSS+IMU* 導航數據



Data Acquisition Software
QPS QINSy

Data Acquisition Unit

Navigation 導航



SatRef Data Application

香港衛星定位參考站數據的應用

● Real-time

實時

- SatRef RTCM data 香港衛星定位參考站RTCM數據

● Navigation

導航

- Right place
- Right line

正確的地點

正確的線位

- **3G mobile network – dongle**

使用NTRIP的3G網路硬件



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SatRef Data Application

香港衛星定位參考站數據的應用

● Post Processing 後處理

- SatRef RINEX data 香港衛星定位參考站RINEX數據
- IMU data IMU數據

● Process 處理

- **Telecommunication outage** 電訊訊號中斷
- **GNSS outage** 全球導航衛星訊號中斷
 - **Under bridge** 橋下通過
 - **Near shore / tall structure** 近岸 / 高建築 / 大船



Problem – 問題 電訊盲點 Telecommunication Blind Spots





Problem – 問題

GNSS Outage Under bridge

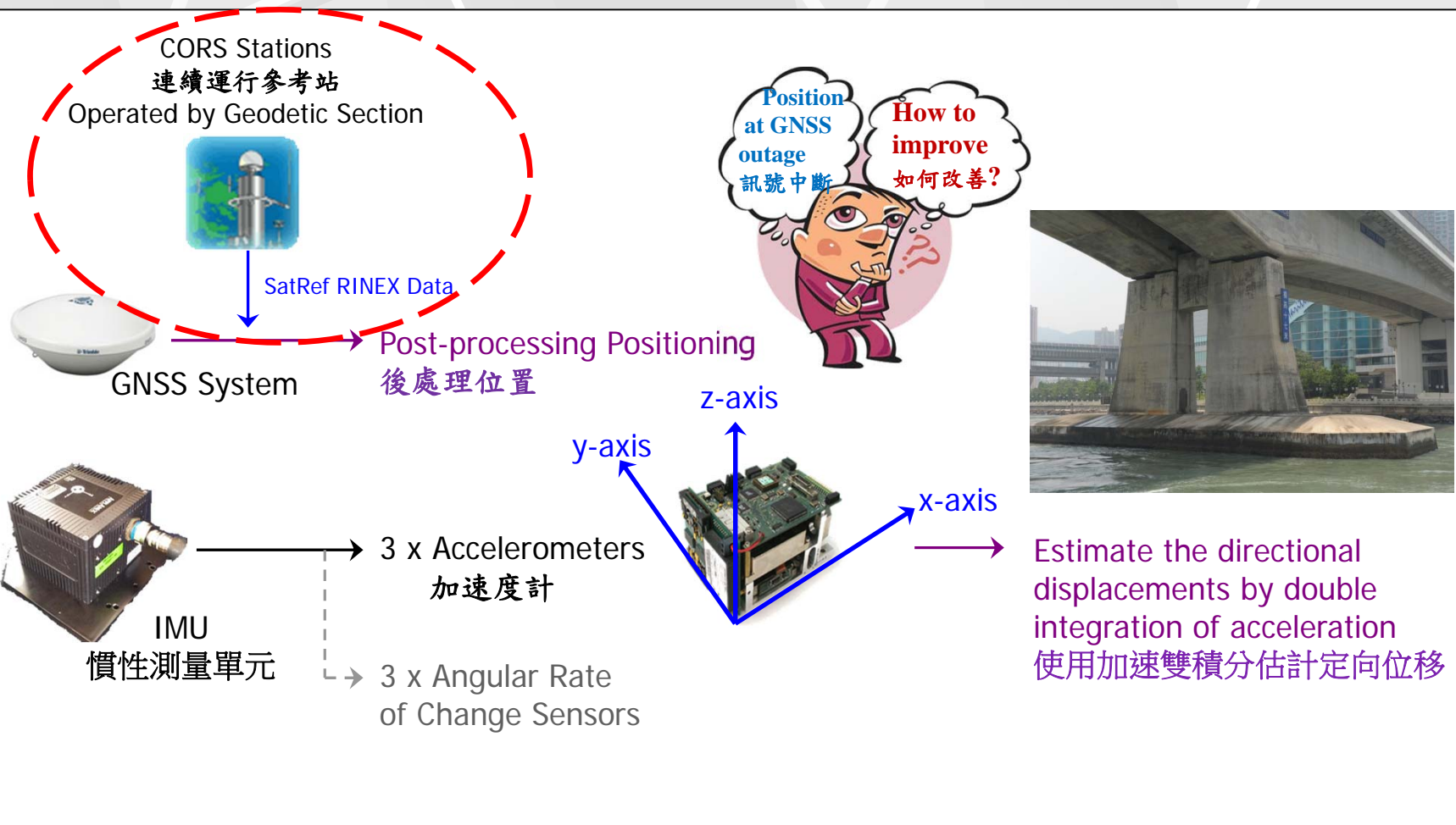
全球導航衛星系統訊號在橋下中斷





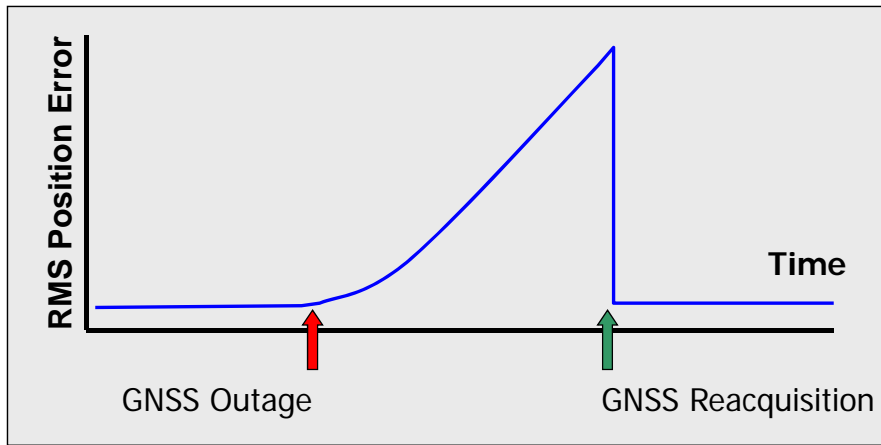
Position Improvement for GNSS Outage

全球導航衛星系統訊號中斷的位置改善

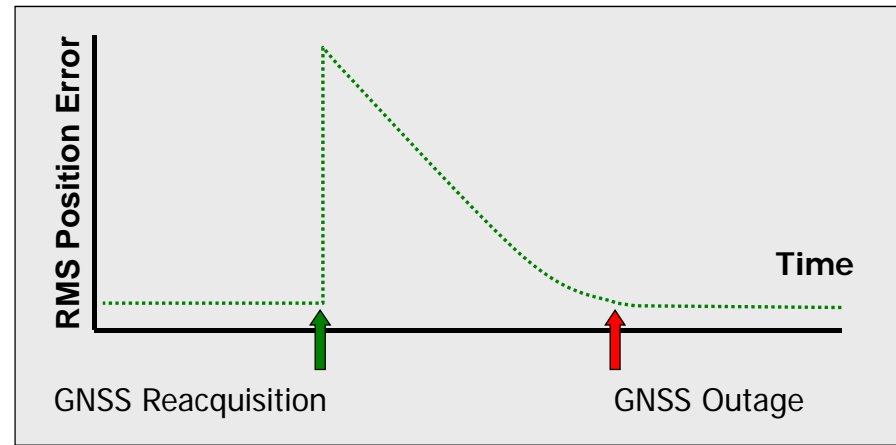




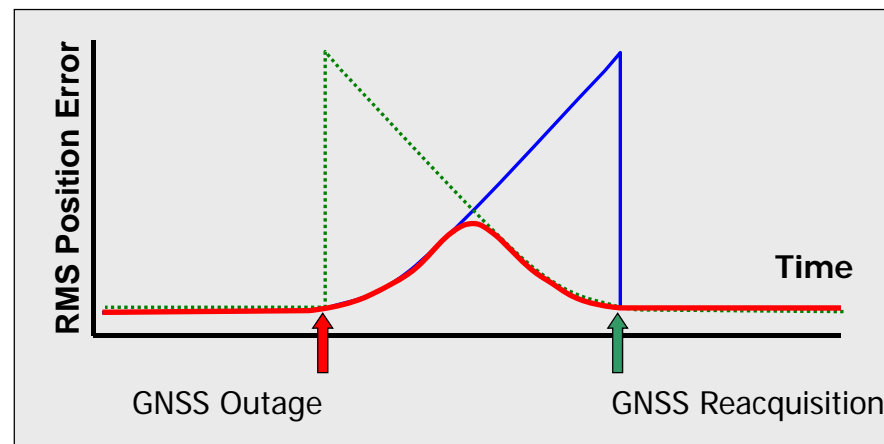
Smoothed Best Estimate of Trajectory (SBET) 平滑的最佳估計軌跡



Forward Processing of Inertial Data 順向的慣性數據處理



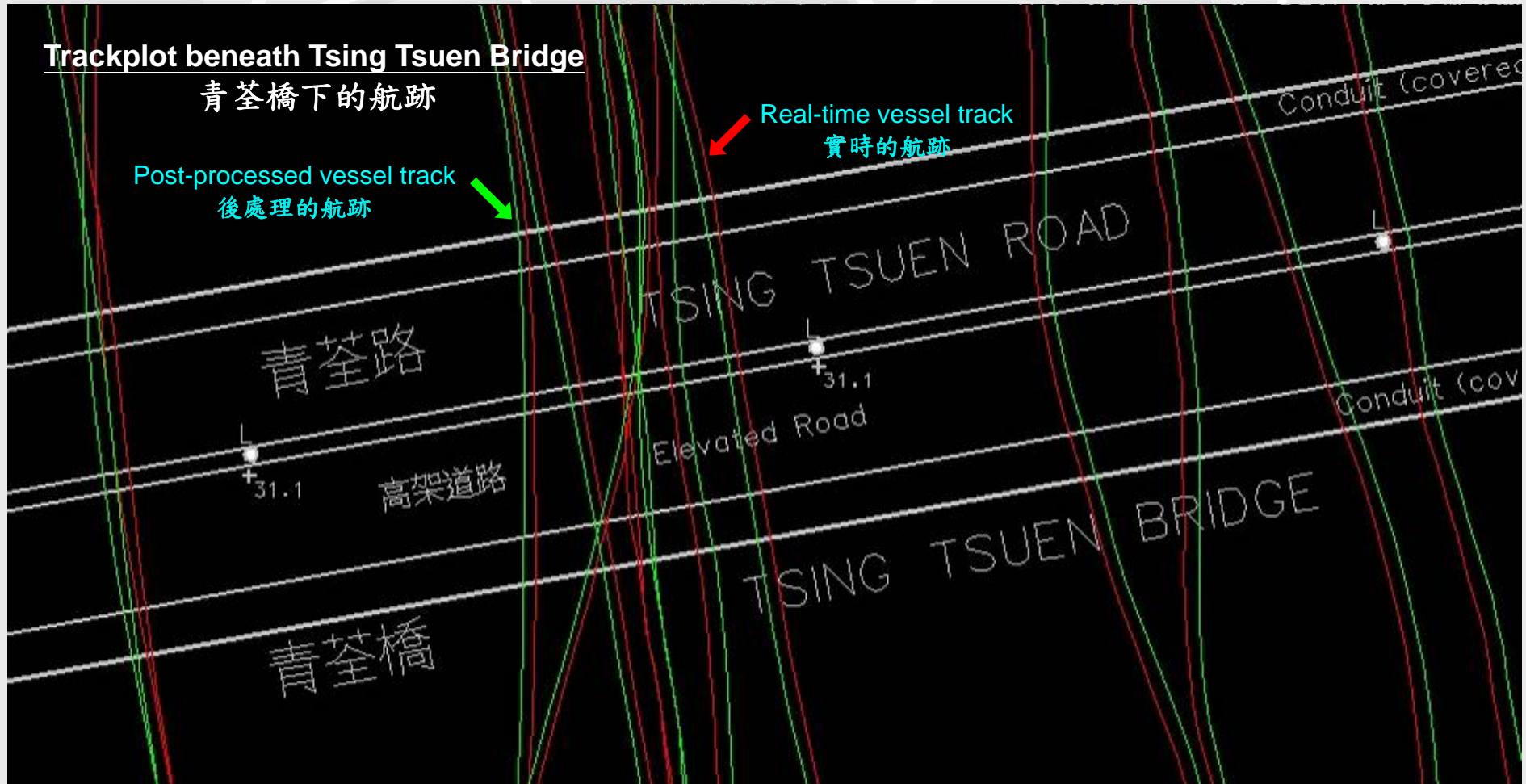
Backward Processing of Inertial Data 逆向的慣性數據處理



Smoothed and Combined Trajectory 平滑和組合軌跡



Real-Time vs. Post-Processed 實時與後處理





Example - Tsing Tsuen Bridge

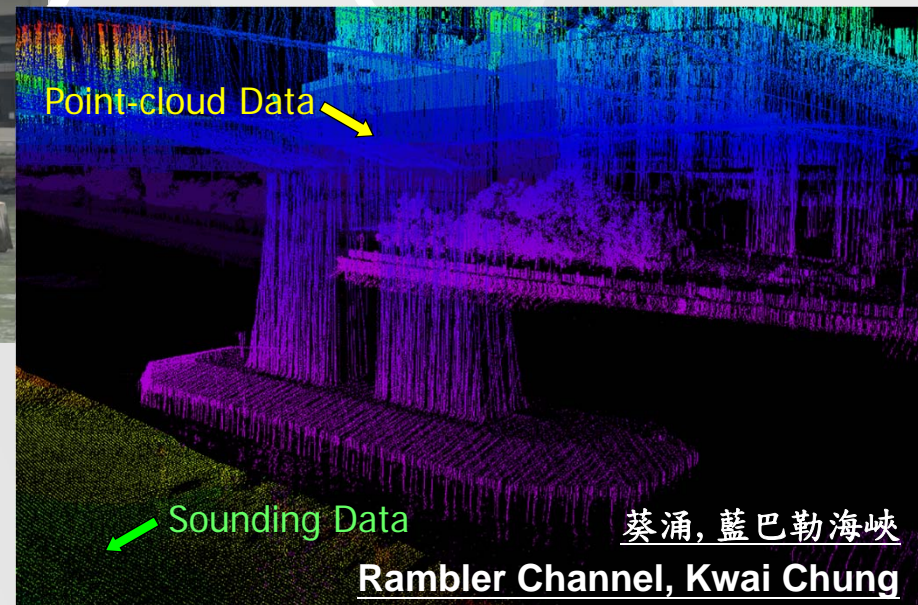
例子 - 青荃橋



GNSS outage when vessel passes through the Tsing Tsuen Bridge

全球導航衛星系統信號在橋下中斷

Post-processed SBET data improves data quality and reliability
平滑的最佳估計軌跡數據提高數據的質量和可靠性





Vessel-based Mobile Mapping System

船載移動測繪系統

Performance of point cloud:
Horizontal: 91mm(2σ)
Vertical : working on applying
ellipsoidal separation with
software automatically

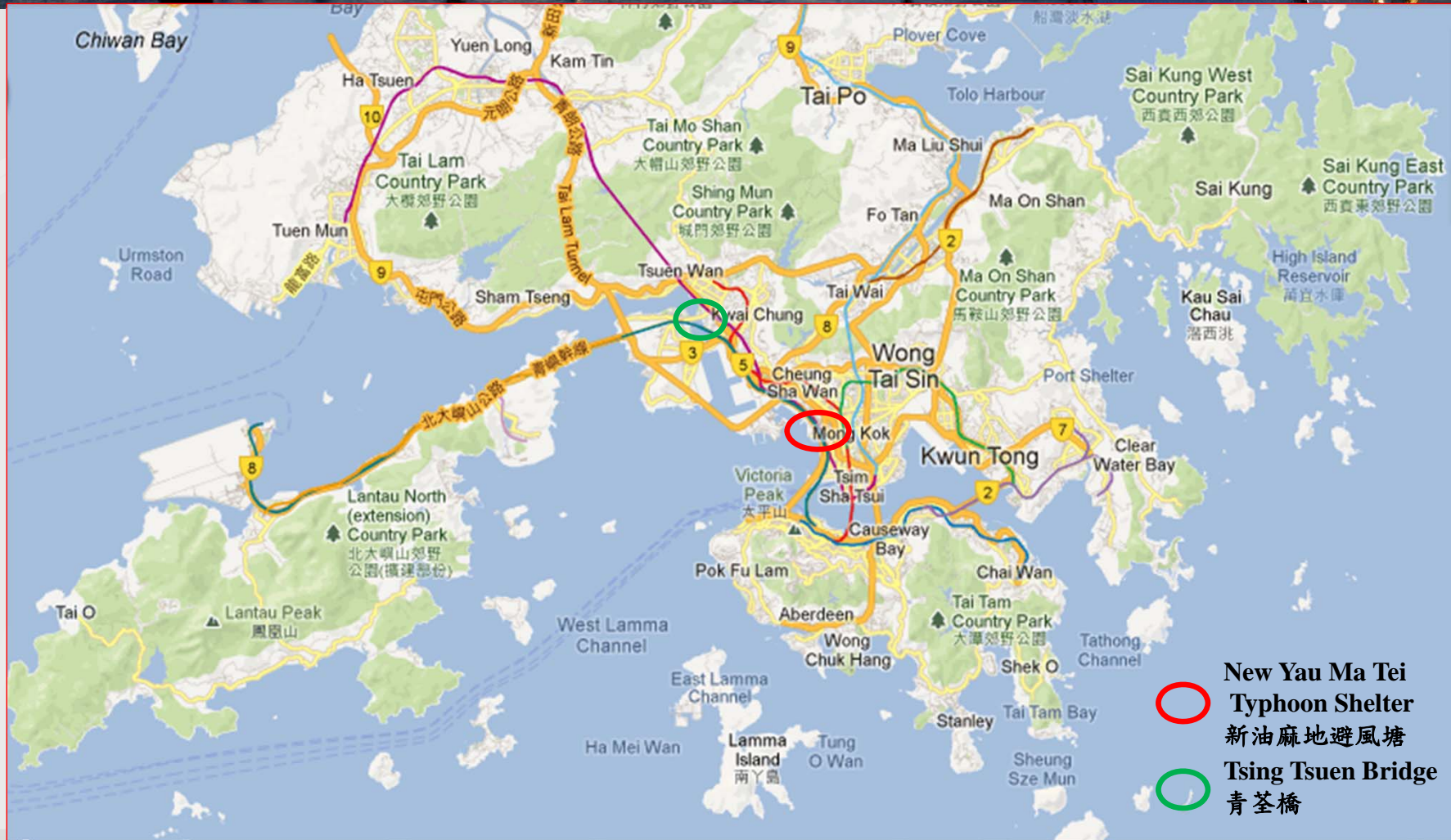
40 deg

130 deg

Sounding requirement :
Horizontal : 1.5m (much better)
Vertical : 0.25m~0.35m (met)



Practical applications 實際應用

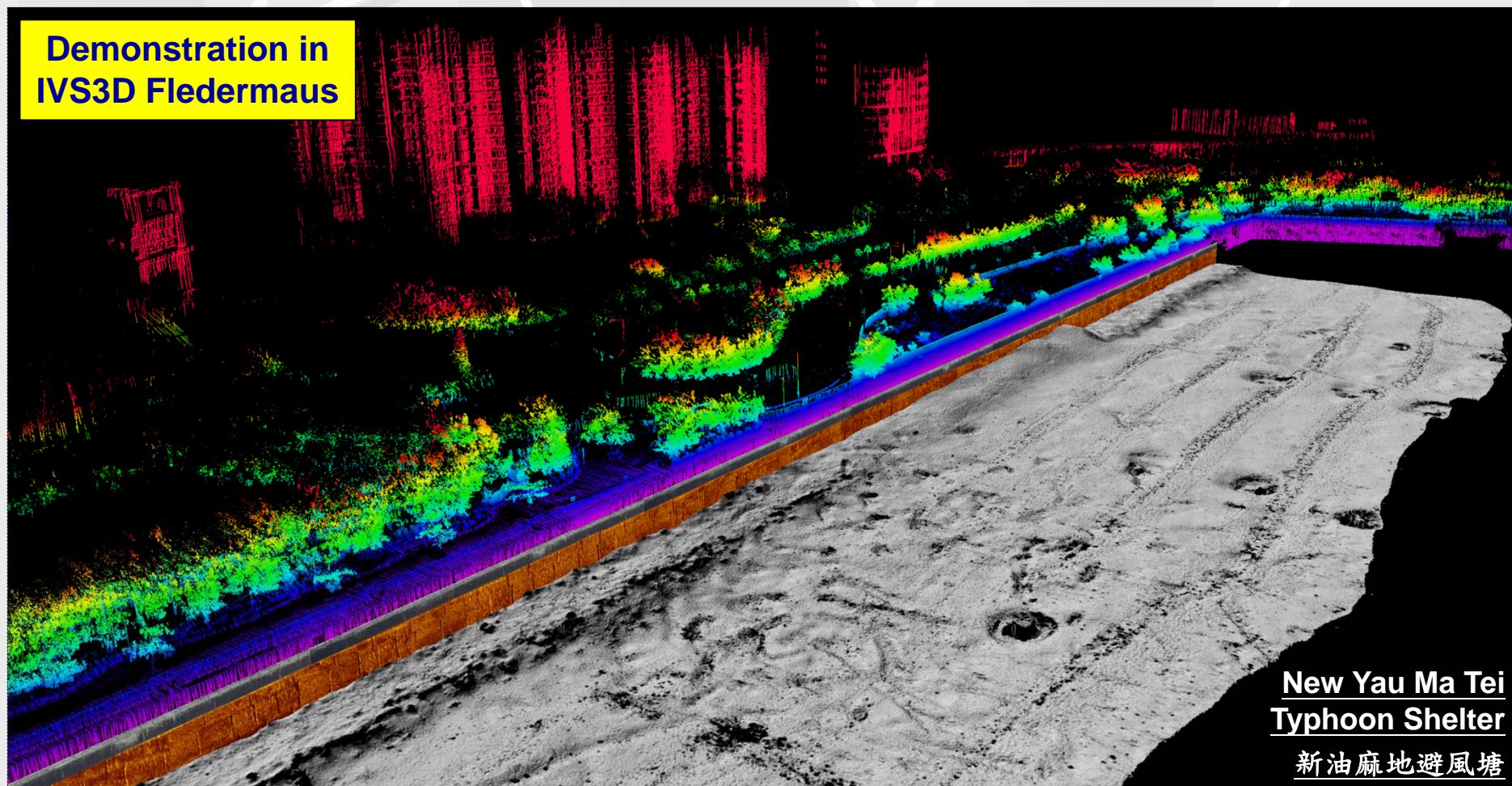




Landing Facilities at One Silversea, Tai Kok Tsui

大角咀一號銀海登岸設施

Demonstration in
IVS3D Fledermaus



New Yau Ma Tei
Typhoon Shelter

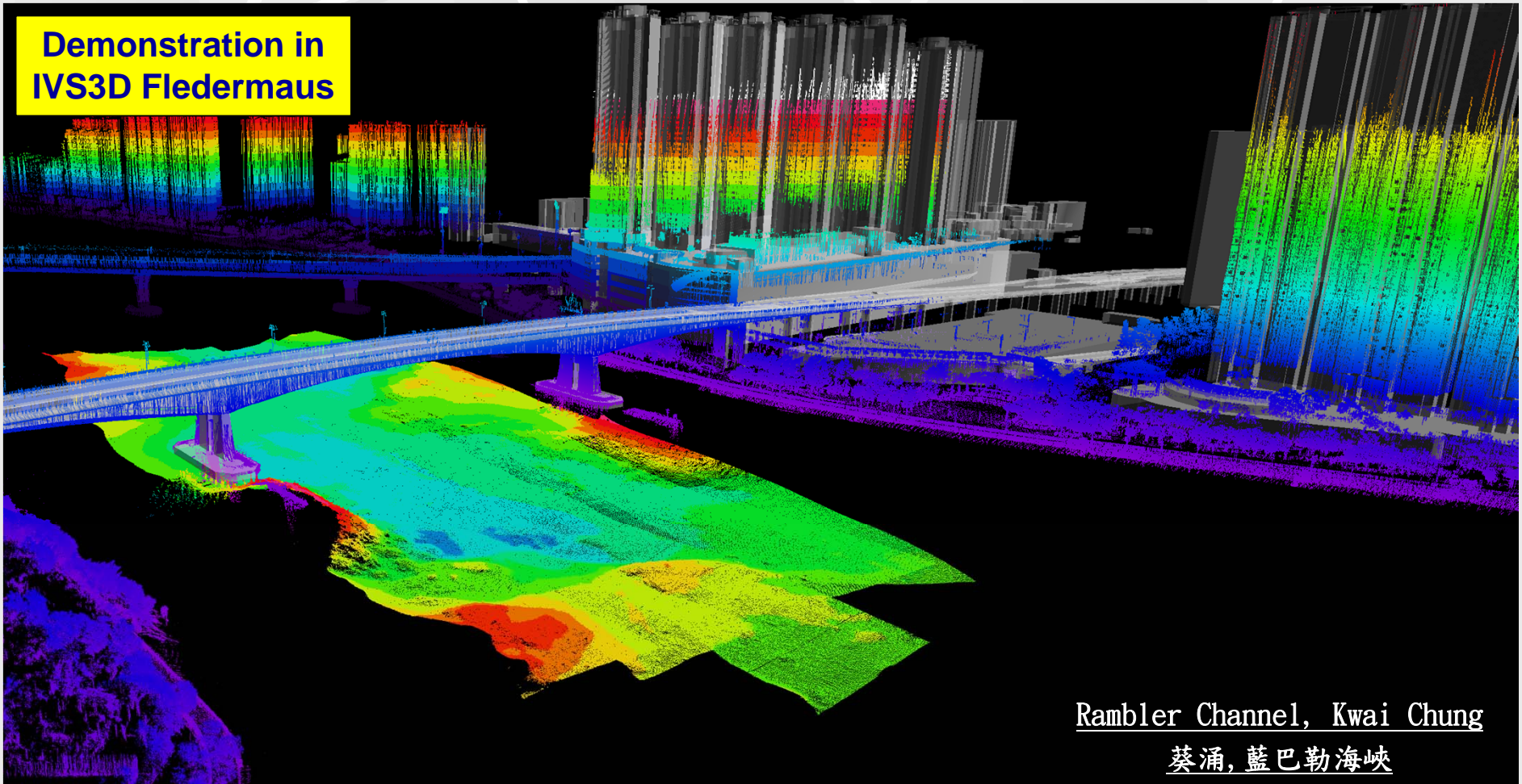
新油麻地避風塘



3-D Modelling of Tsing Tsuen Bridge

青荃橋的三維建模

Demonstration in
IVS3D Fledermaus



Rambler Channel, Kwai Chung

葵涌, 藍巴勒海峽

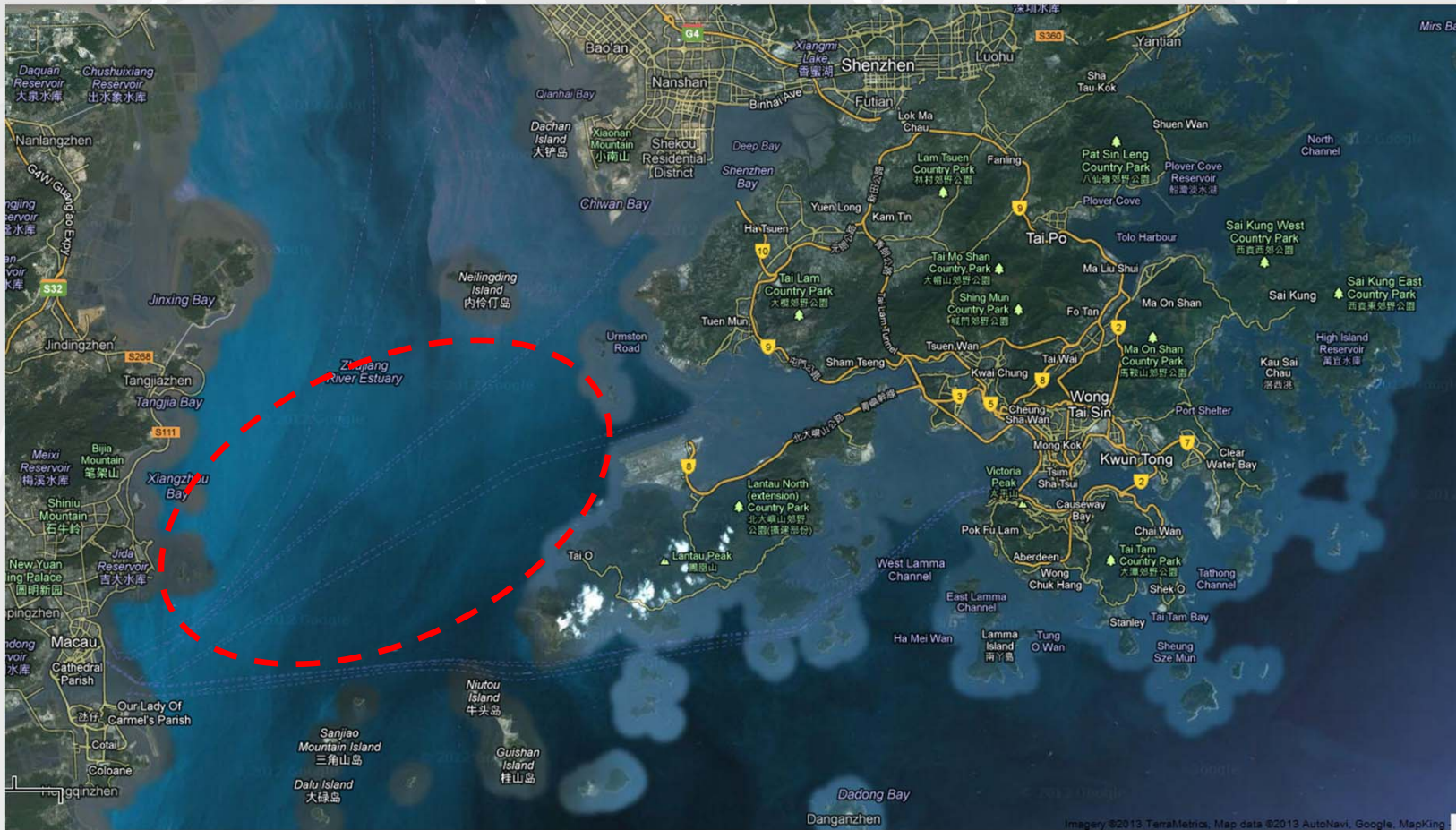


Possible application – 可能的應用

GPS+GLONASS & Sharing of Reference Station Data -

雙衛星定位與香港及澳門參考站數據共享

Cross-border road & bridge project 跨境道路及橋樑項目





Vessel-based Mobile Mapping System (V-MMS)

船載移動測繪系統

Thank You !
謝謝!

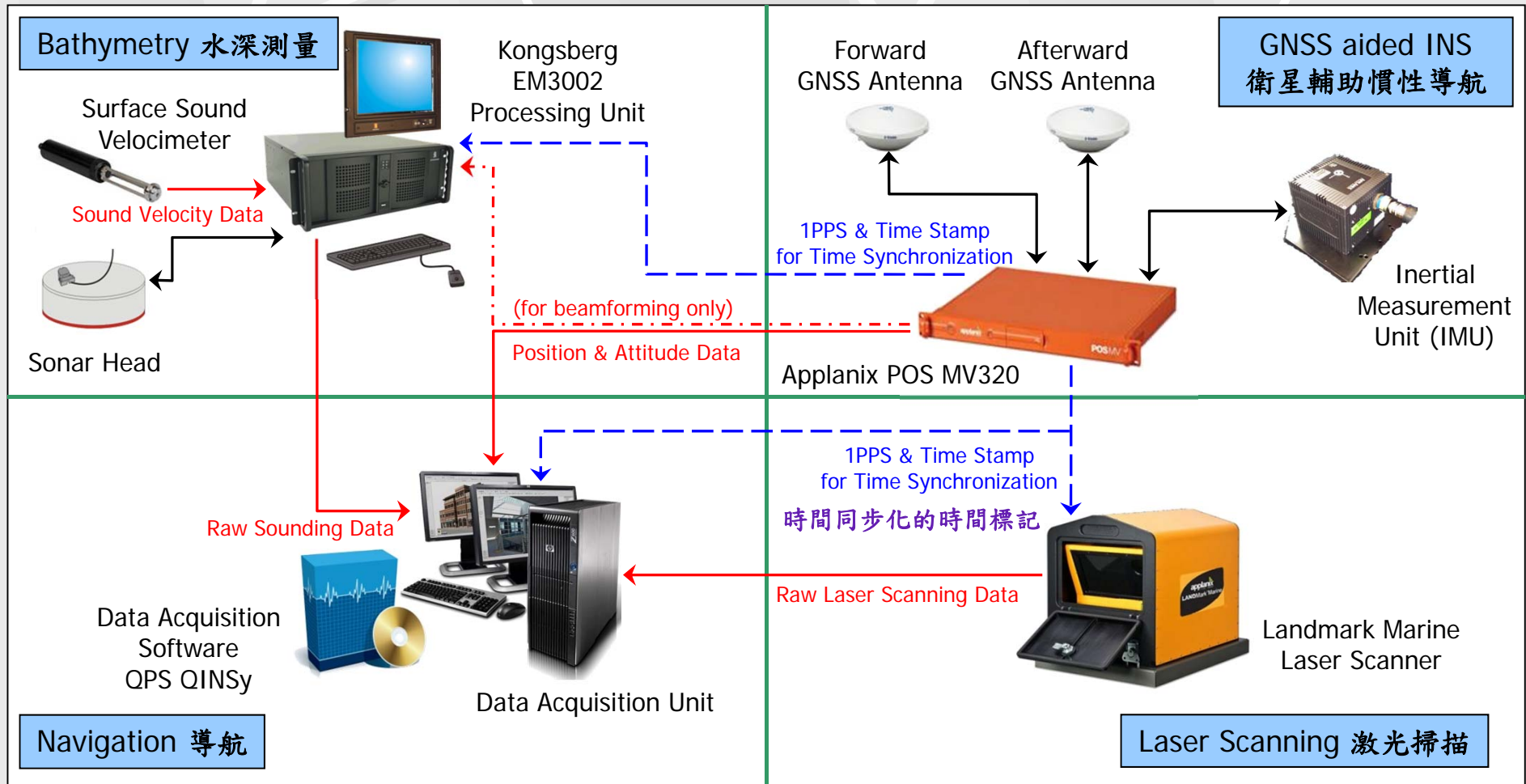




Extra slides



System Architecture 系統結構





VMMS - Operation Diagram

船載移動測繪系統 - 操作圖

船載移動測繪系統 Vessel-Based Mobile Mapping System (V-MMS)

Operation Diagram

操作圖

