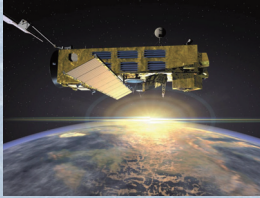


CERES, December 1st 2015

Infrastructure Monitoring via Multi-Temporal InSAR

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with the contribution of
Pietro Milillo**, Yuxiao Qin*, Keng-Fan Lin*, Bob Chim*
* Purdue, ** NASA JPL

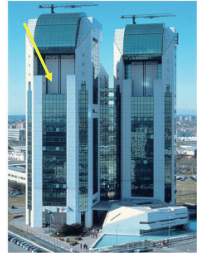
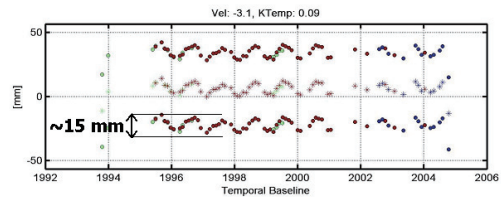


Lyles School of Civil Engineering



InSAR Time series analysis of a building

The Seasonal thermal expansion component



Gemini towers, Milan

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Infrastructure Monitoring via Multi-Temporal InSAR

Outline

- **Scope:** infrastructure is key element in the economy. Aging is a fact and monitoring can save billion of dollars if it can prevent failures
- **Method:** interferometry (from satellites, UAVs, Ground systems) can detect millimeter changes in the radar L.O.S.
- **Issues:** discerning all phase components, isolating and extracting the target displacement, connecting displacement to Aging, implementing an Early Warning system

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The Kowloon Collapse

AT 45J MA TAU WAI ROAD
TO KWA WAN, KOWLOON - K.I.L. 8627
ON 29 JANUARY 2010



CEReS Dan

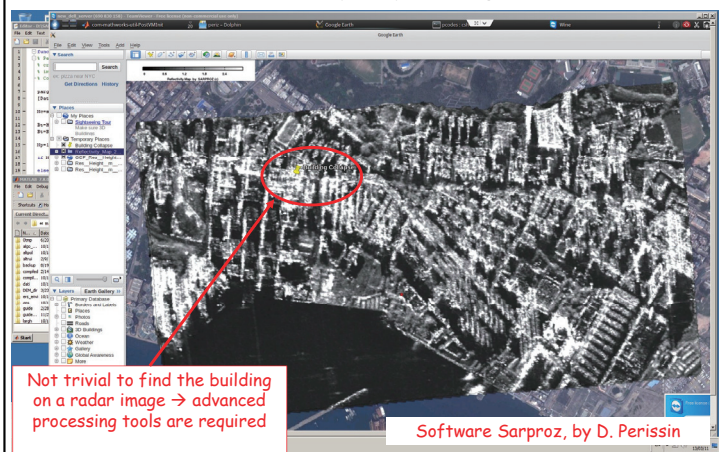
Monitoring buildings

(Examples in Italy and Hong Kong)

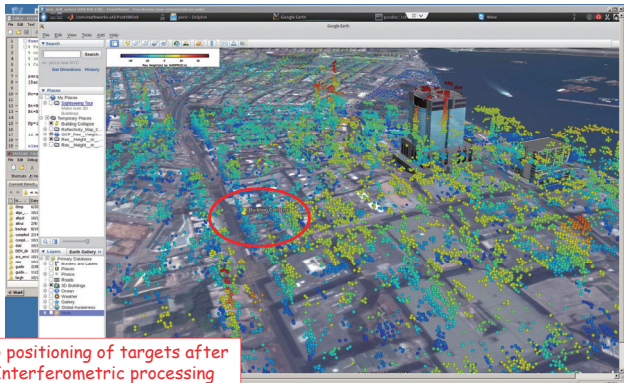
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Radar Reflectivity Map in Google Earth



Detected Radar Targets in Google Earth

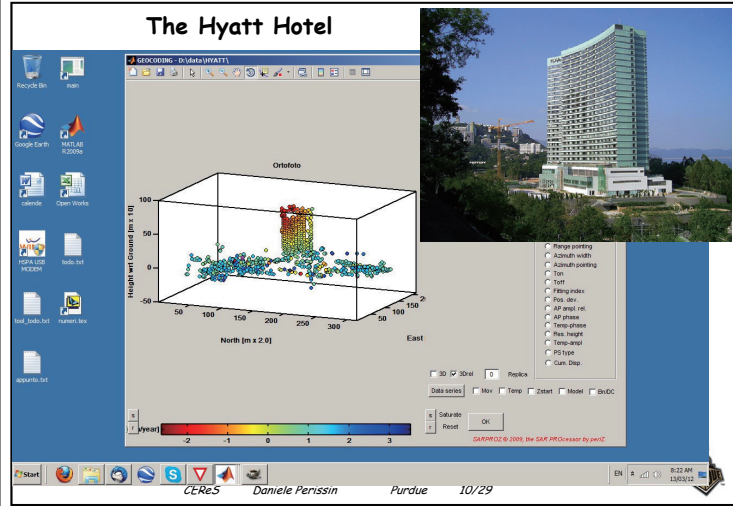


3D positioning of targets after Interferometric processing

Software Sarproz, by D. Perissin

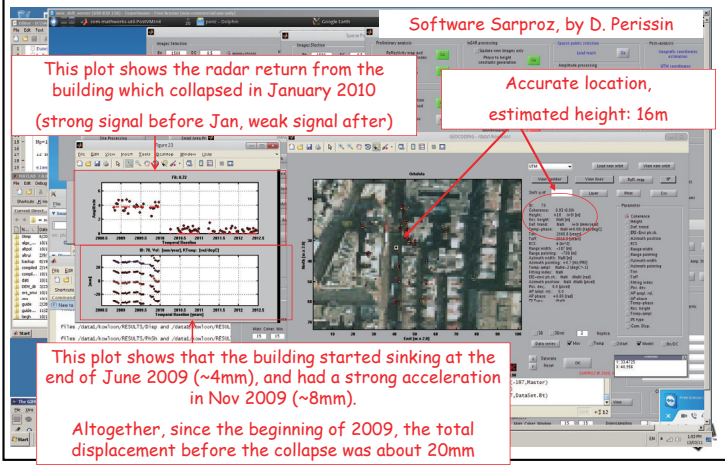
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The Hyatt Hotel



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The Kowloon Collapse



Software Sarproz, by D. Perissin

This plot shows the radar return from the building which collapsed in January 2010 (strong signal before Jan, weak signal after)

Accurate location, estimated height: 16m

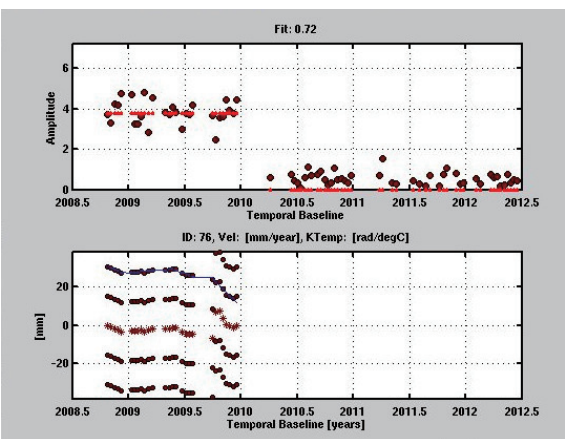
This plot shows that the building started sinking at the end of June 2009 (~4mm), and had a strong acceleration in Nov 2009 (~8mm)

Altogether, since the beginning of 2009, the total displacement before the collapse was about 20mm

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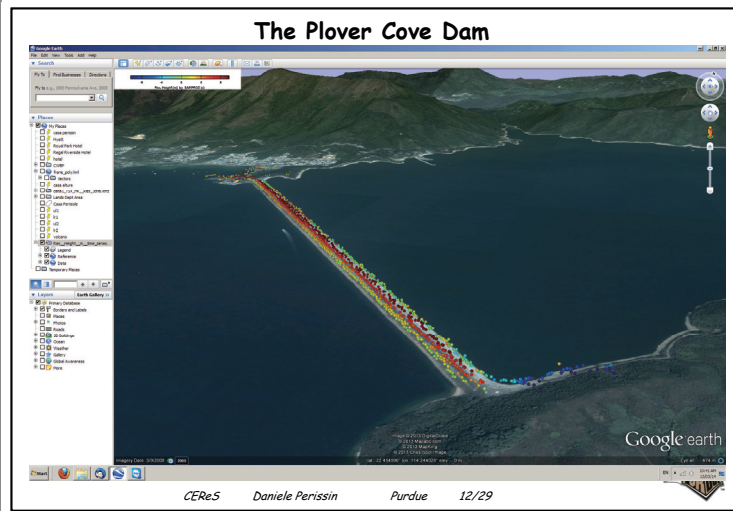
Monitoring dams

(Examples in Hong Kong and Italy)



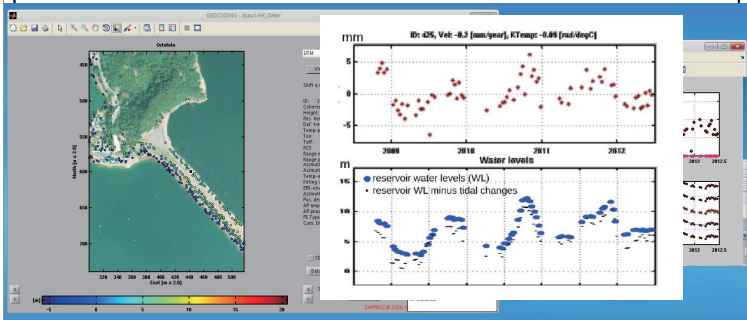
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The Plover Cove Dam



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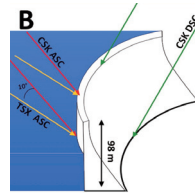
The displacement of the Dam



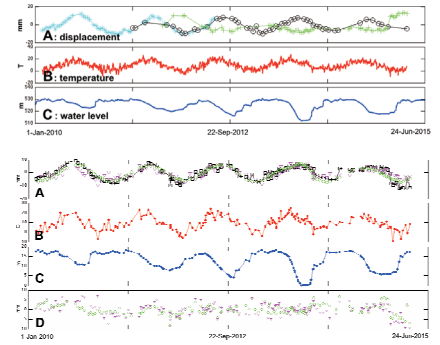
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Hydrostatic-Temperature-Temporal Model



HOR-VER decomposition

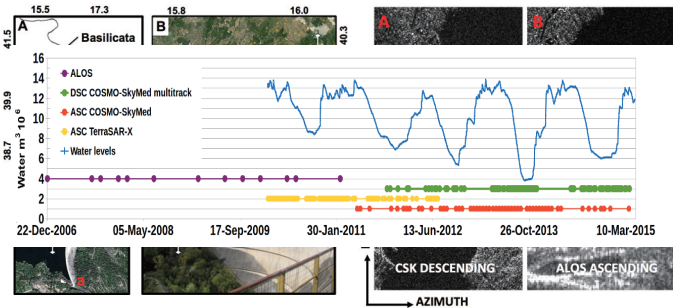


→ Estimation of the Aging component

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Multi-Sensor analysis of a Dam in Italy



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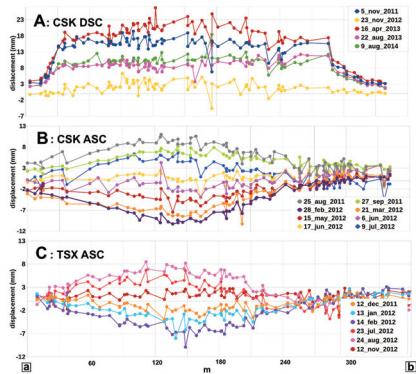
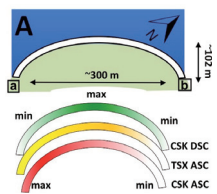
Monitoring roads

(Examples in USA)

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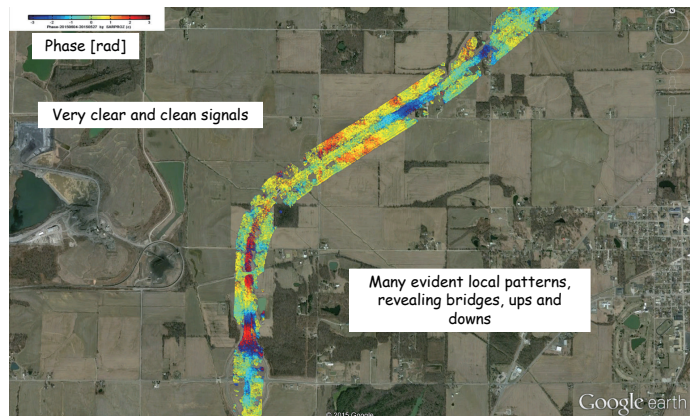
Instantaneous Dam elongations



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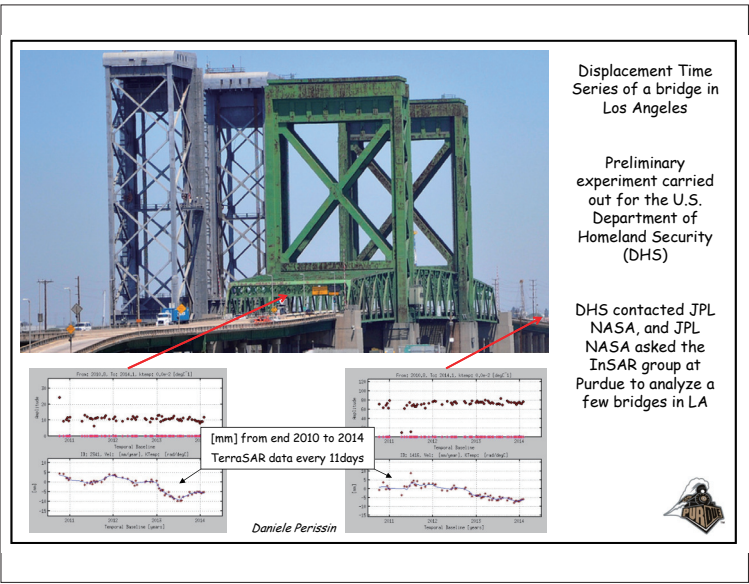
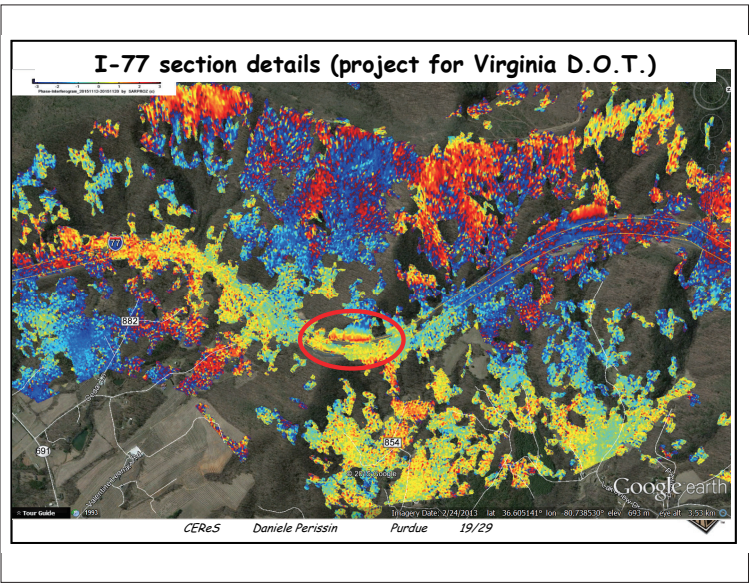


I-69 section details (project for Indiana D.O.T.)



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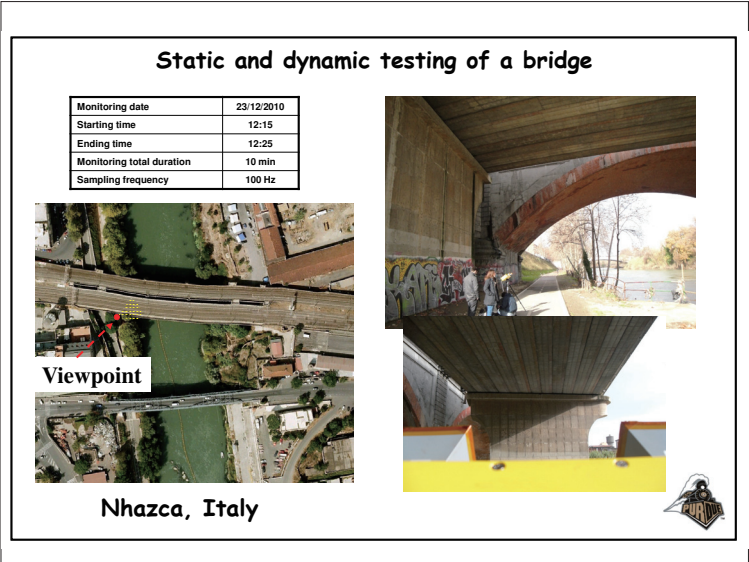
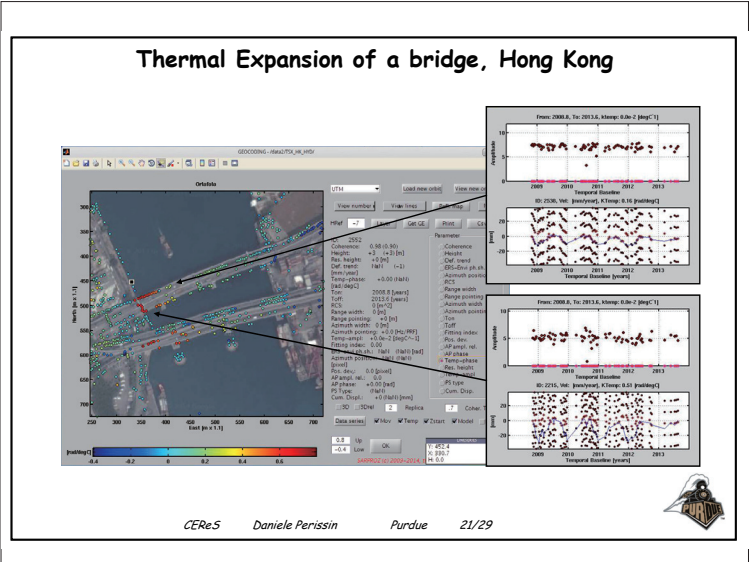
Monitoring bridges

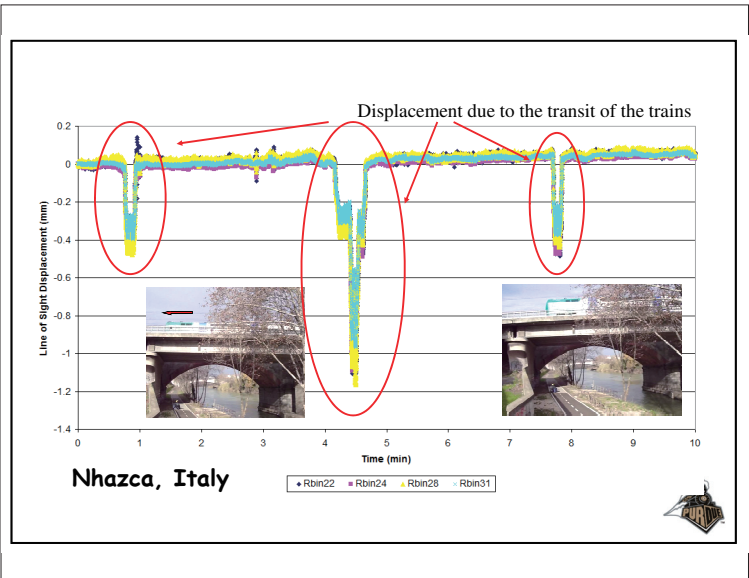
(Examples in Hong Kong and USA)

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Ground Based RADAR

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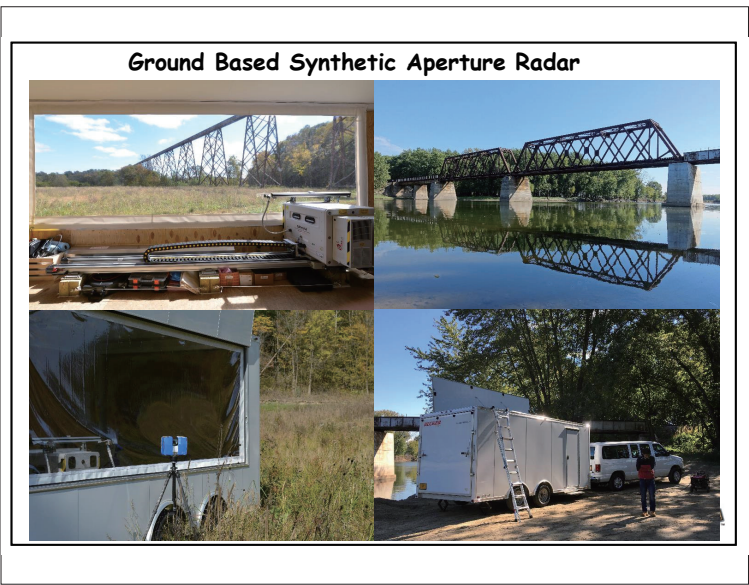


Infrastructure Monitoring via Multi-Temporal InSAR

Conclusions

- Multi-Temporal InSAR is mature enough for being used systematically for infrastructure monitoring
- Sometimes the limitation is given by data availability, but more and more satellites will be active in the future
- At Purdue we are now working at ground based systems for complementing satellite observations
- Looking forward to applying these techniques also on UAV Multi-Temporal SAR data!!!

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Infrastructure Monitoring via Multi-Temporal InSAR

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Software SARPROZ
www.sarproz.com

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