

Digital Twin Technology for Intelligent Monitoring and Maintenance of Port Infrastructure

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Significance

- Ports contribute to the Australian economy with 98% of trades being conducted there.
- Ports moves \$1.2 billion worth of trades annually to Australia.
- Ports are more prone to corrosion due to harsh coastal environment
- Loading is more complicated
- From **reactive** maintenance to **preventive** maintenance

Benefits

- Failure Prevention
- Reducing down time.
- Less risk for inspectors
- Digital Twin technology can reduce maintenance costs by up to 40%.



DT for port infrastructure

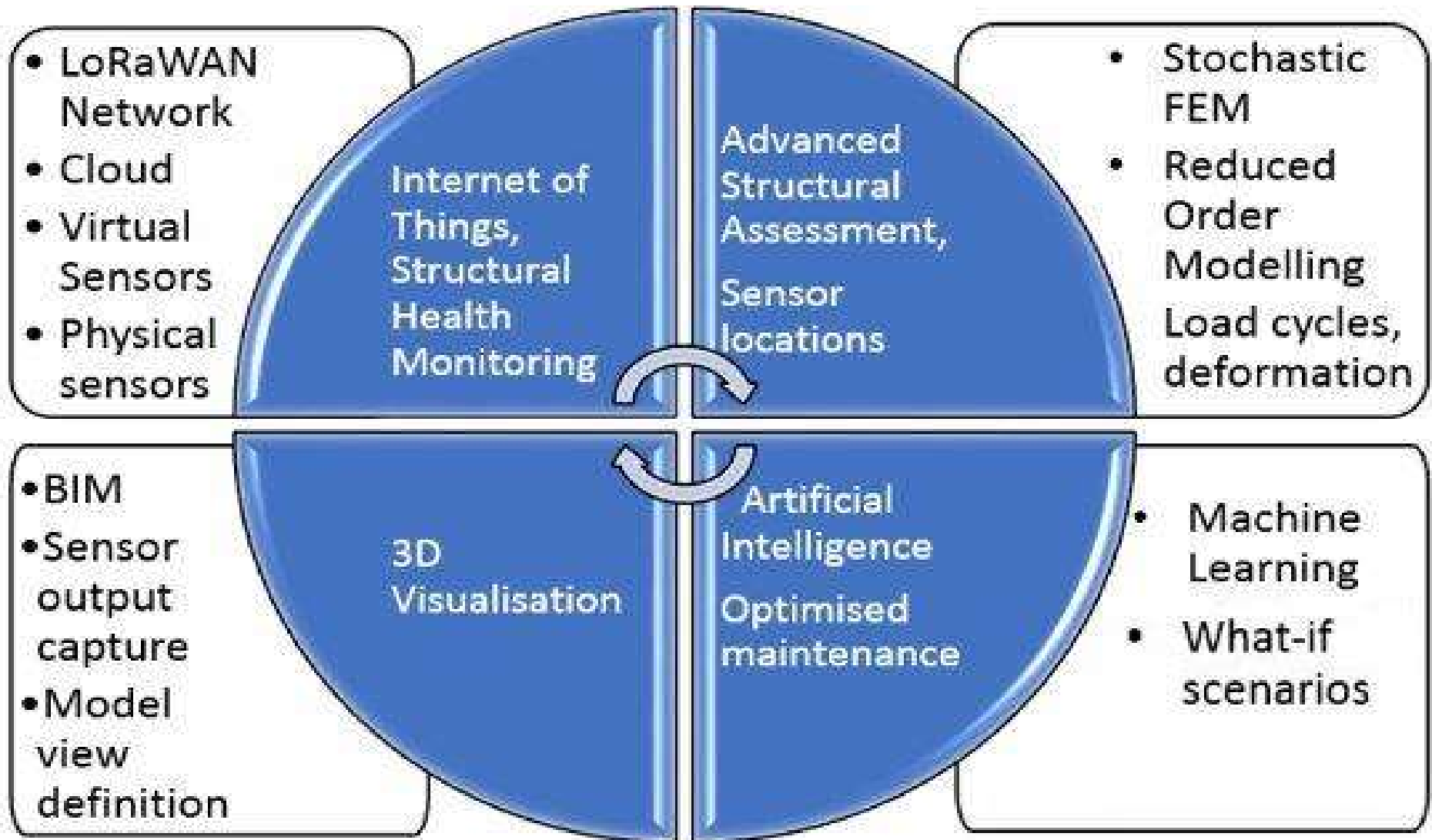




DT for offshore infrastructure



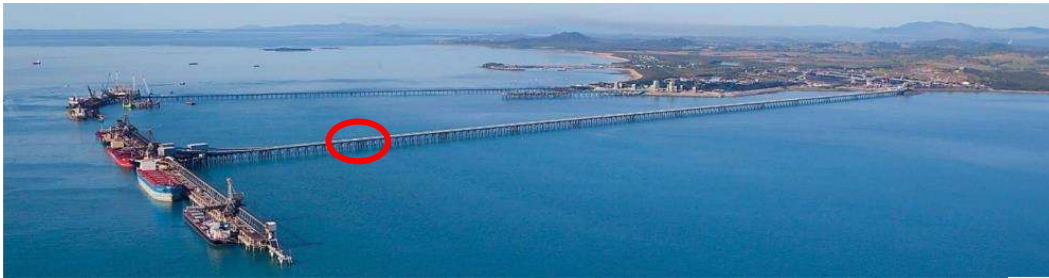
Integration of Technologies



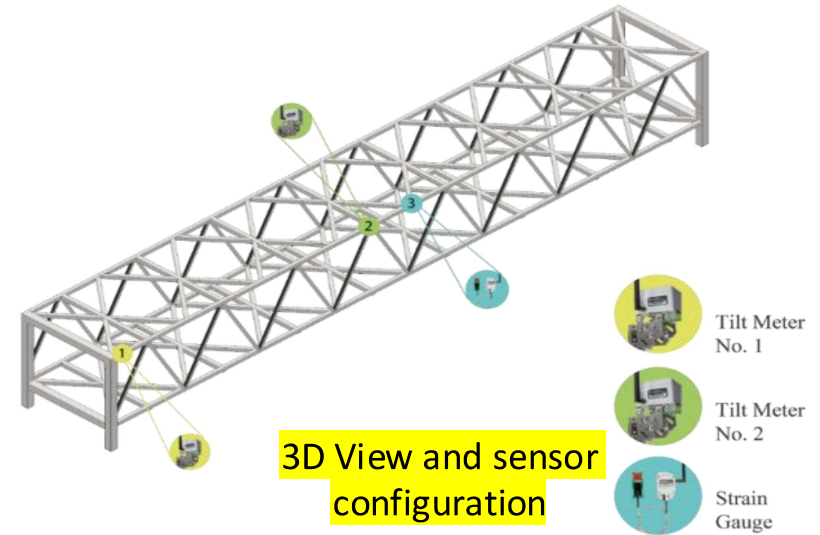
Conceptual framework



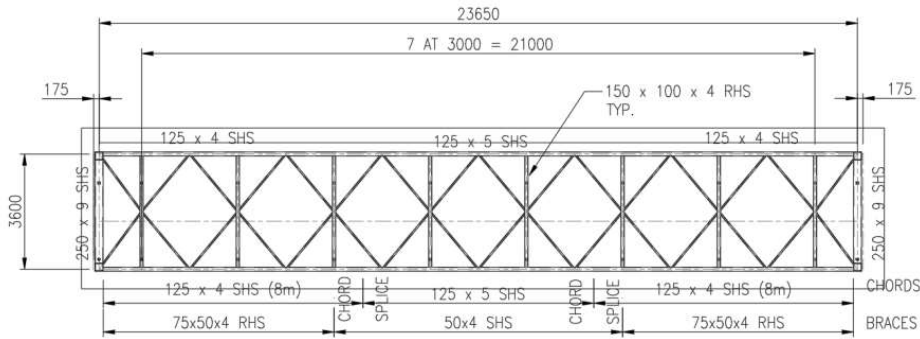
Details about the case study structure



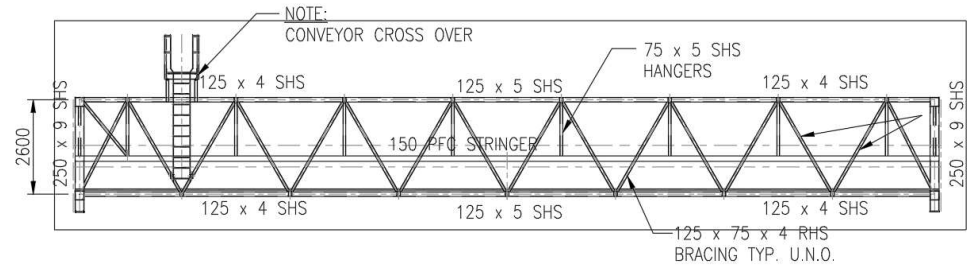
Location of the Jetty Conveyor



3D View and sensor configuration



Plan View

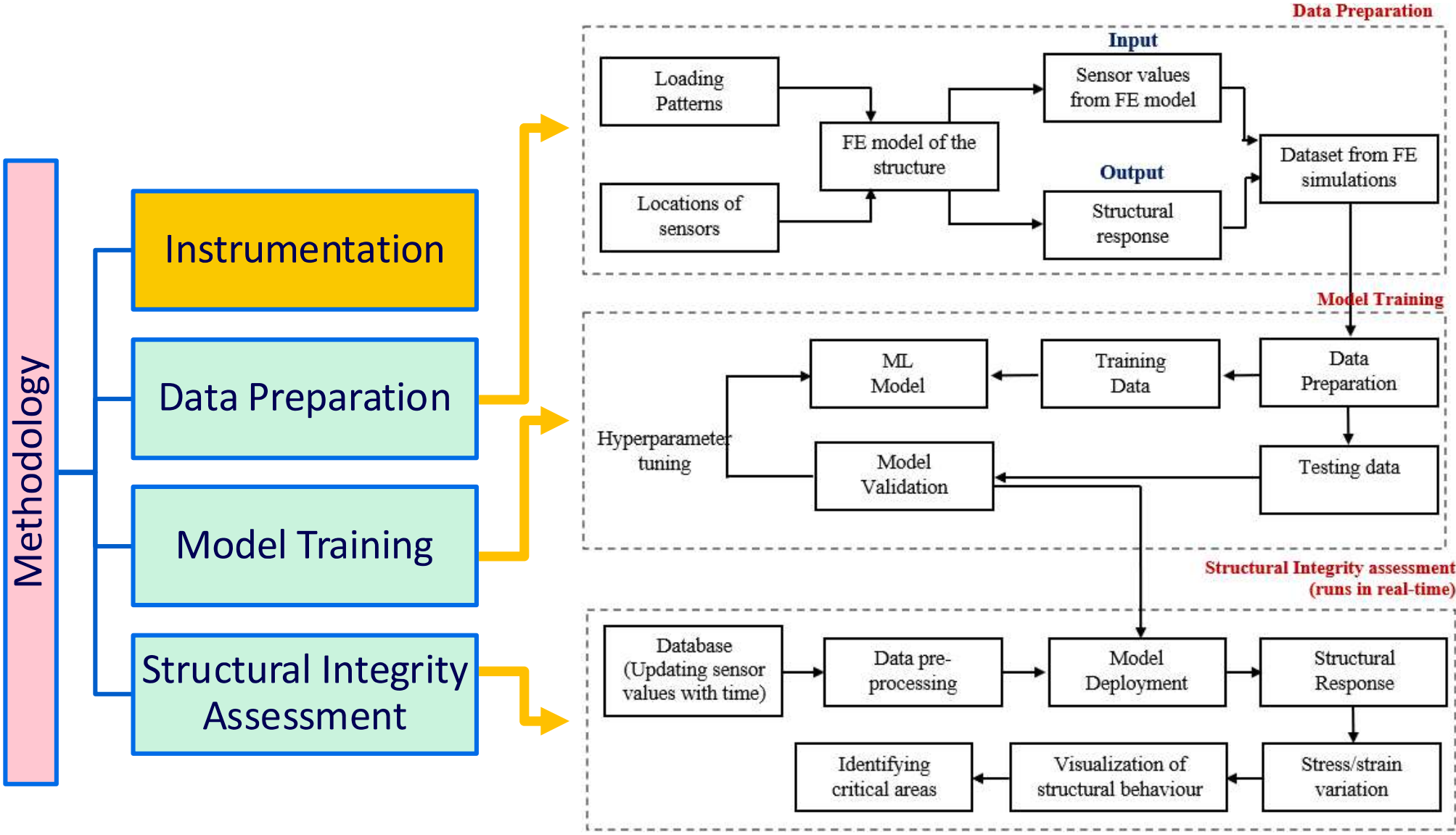


Side View



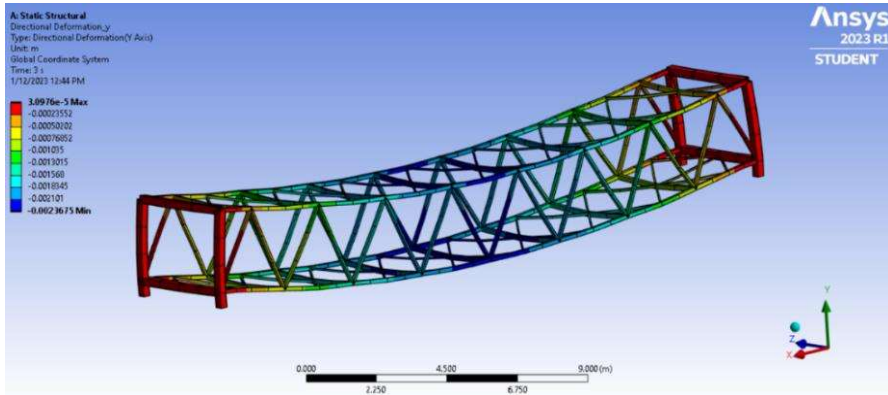


Research Methodology





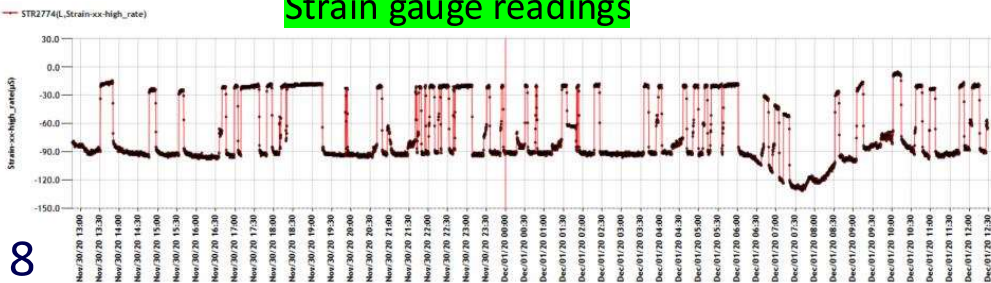
FE modelling, Dataset and Model Validation



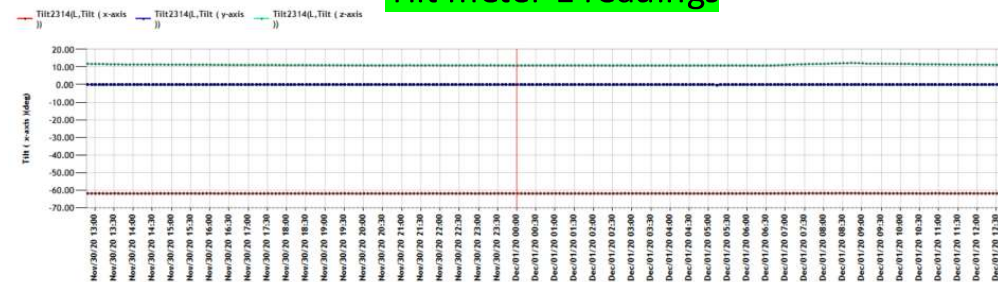
FE model – Generated 10,000 datasets

Sensor	AVG (measured)	Obtained value from FEM dataset
Tilt meter 1 (in degrees)		
• X-axis	53.8	53.65 – 53.87
• Y-axis	2.69	2.49 – 2.86
• Z-axis	13.91	13.48 – 14.38
Tilt meter 2 (in degrees)		
• X-axis	-61.5	(-61.57) – (-60.27)
• Y-axis	-0.032	(-0.15) – (0.08)
• Z-axis	12.47	11.54 – 13.32
Strain Gauge (10^{-6})	-76.83	(-96) – (-4.8)

Strain gauge readings

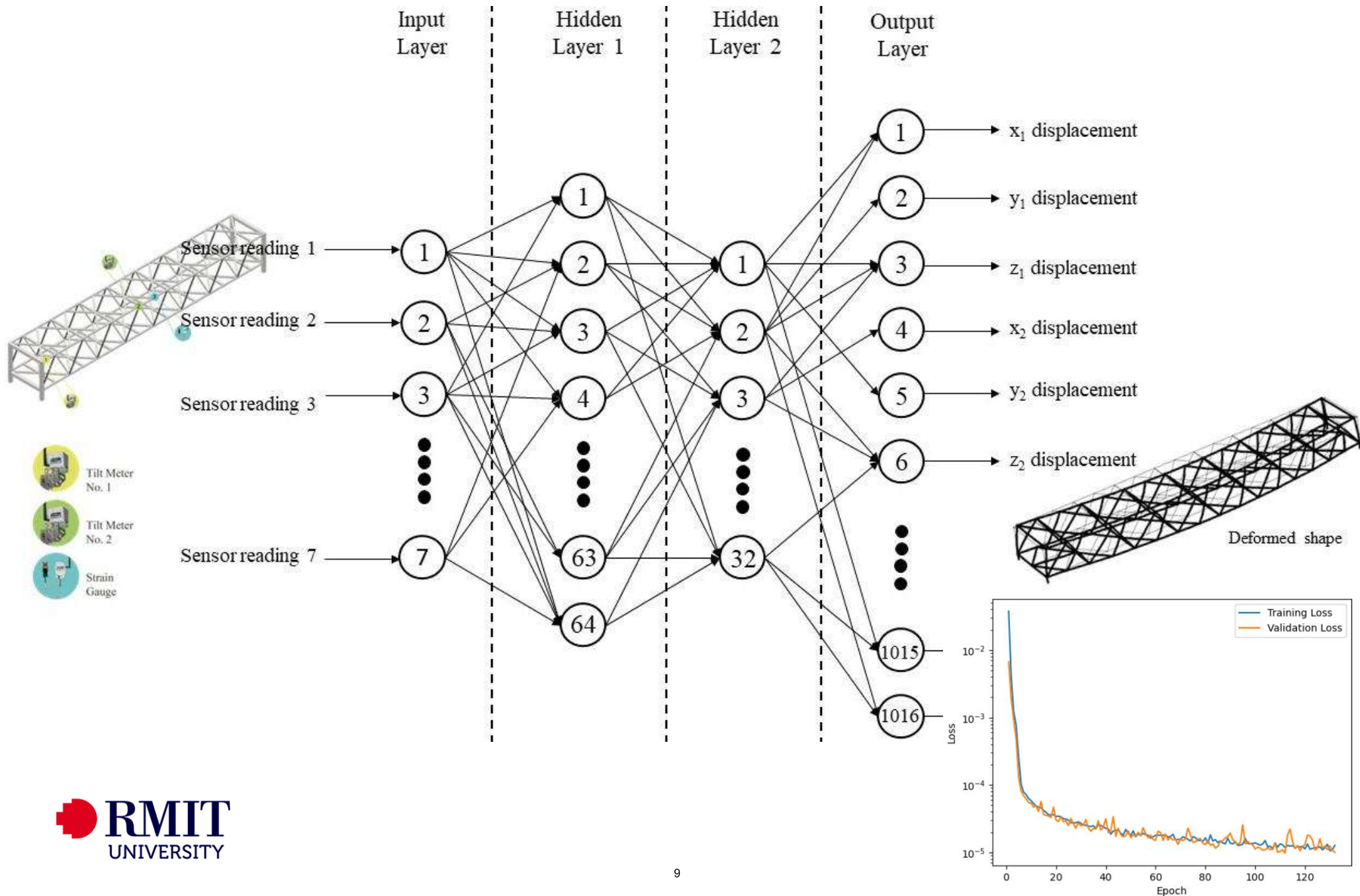


Tilt meter 1 readings



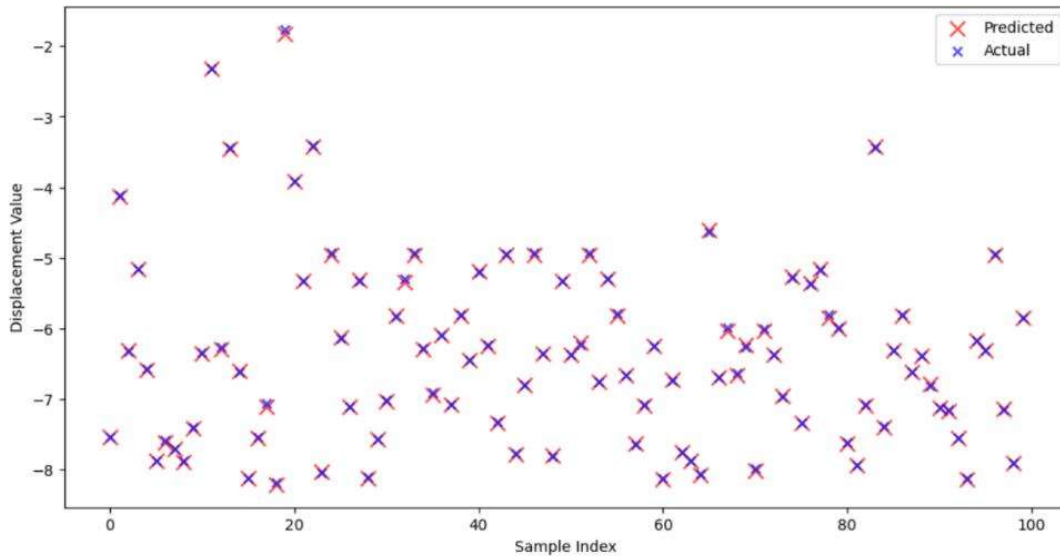


ANN model (Multi-layer Perceptron) and Training



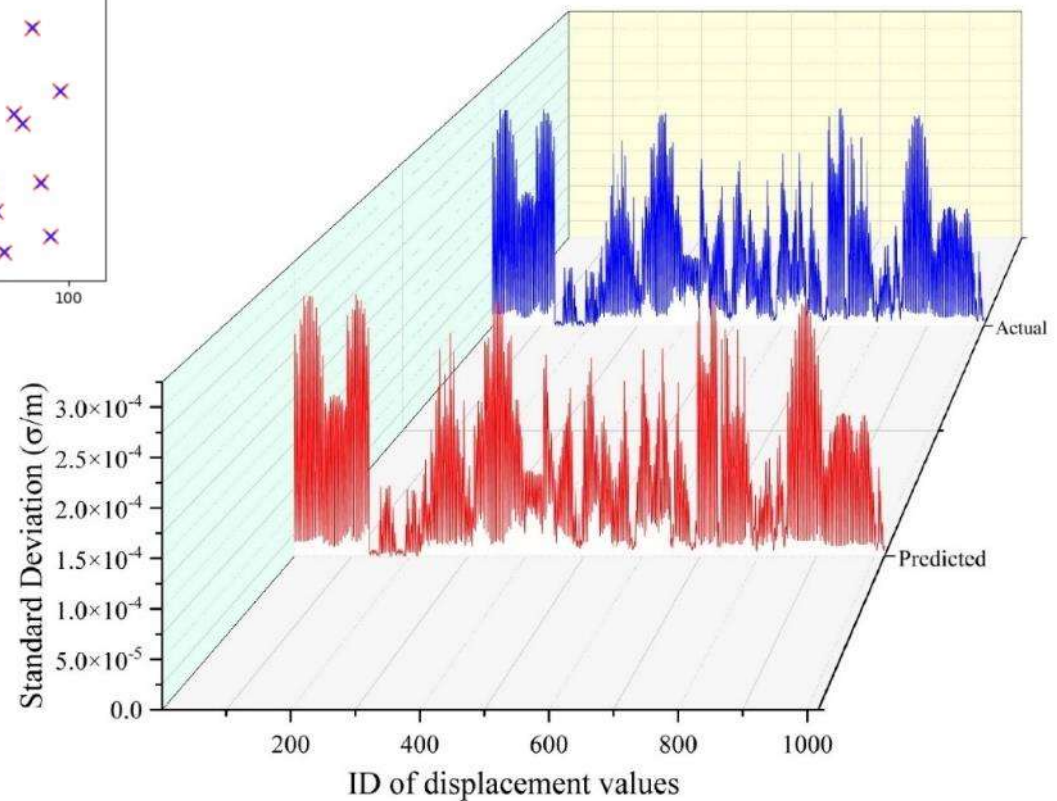


Results



Time to generate an output = 15 ms
(2000 times faster)

Data set	RMSE
Training	2.103e-05
Testing	2.136e-05
Validation	2.119e-05

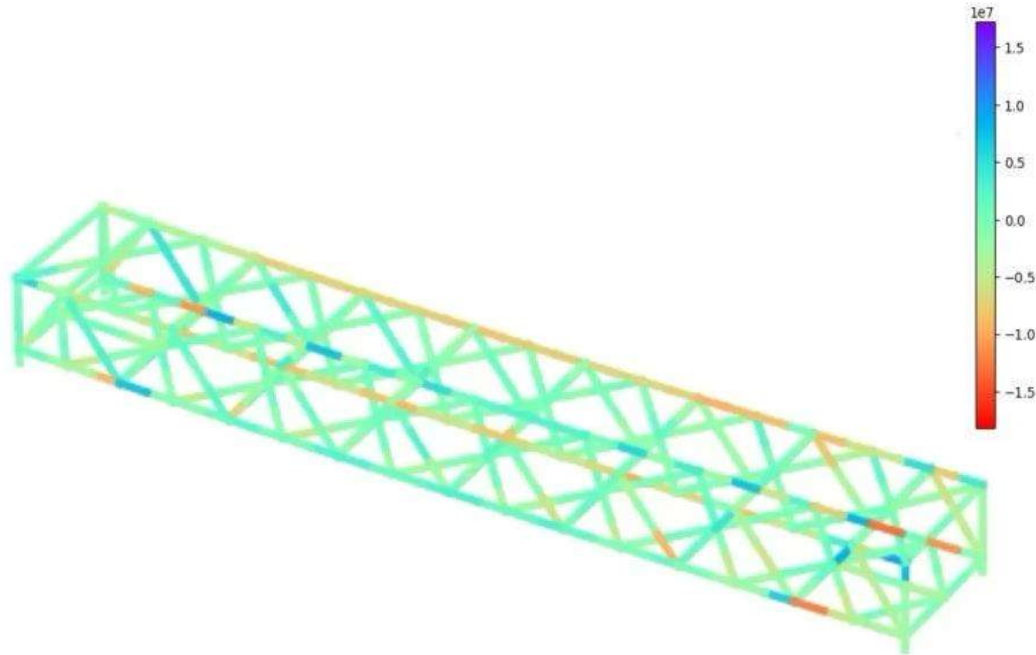


RMSE – Relative Mean Squared Error





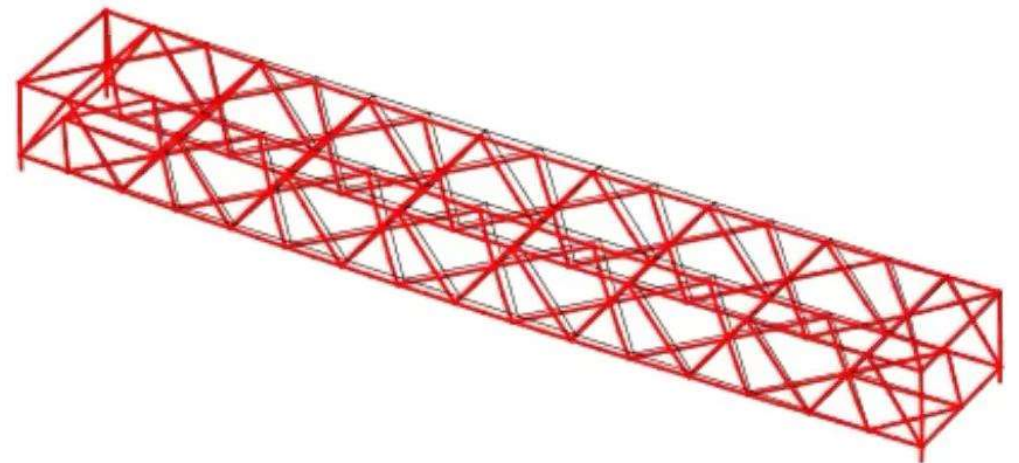
Real-time Visualization



Displacement variation of the structure over time



Stress variation of the structure over time



* SDGs aligned directly to asset management



- Minimise pollution
- Minimise energy use
- Optimise investment
- Leads to innovation
- Enhance sustainability of cities and communities
- Reduce construction and demolition waste
- Minimise climate impact

1
2



* SDGs aligned directly to digital twin of ports





Thank You

Contributed Researchers

Sanduni Jayasinghe

Amir Sidiq

Farham Shahrivar

Zhiyan Sun