Using OBSI measurements of road surface corrections to improve noise modelling predictions

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global **environmental** and **advisory** solutions

Introduction to SLR Acoustics & Vibration

- Acoustics & Vibration is one of SLR's key environmental disciplines in New Zealand.
- Supported by Australia's largest acoustical consultancy with a strong reputation for involvement in landmark projects in operation for over 35 years.
- Long history of involvement in road projects and has earned a respected and highly credible reputation with regulatory authorities and with the community in general.

New South Wales	Queensland	Victoria
Westconnex M4	Legacy Way Tunnel EIS	North East Link
Westlink M7	Clem7 Tunnel EIS	Mitcham Frankston Freeway
Cross City Tunnel	Airport Link EIS	Deer Park Bypass
Sydney Harbour Tunnel	Sunshine Motorway	M80 Upgrade
Pacific Highway Upgrades	Cunningham Highway	East Link Tunnel

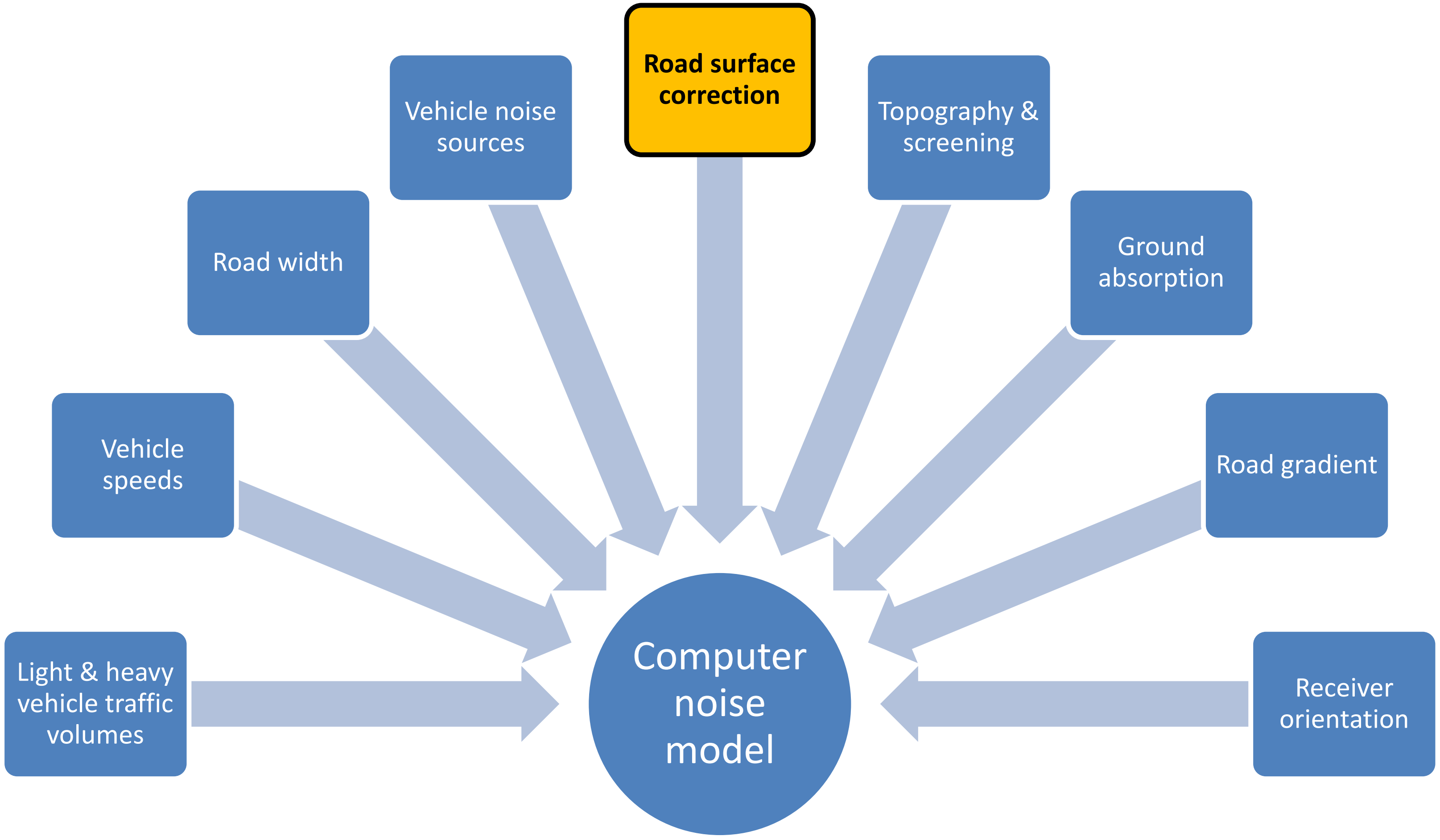
Introduction

Current assessment framework, assumptions, and procedures.

Introduction

- Environmental Impact Assessments for major road developments include computer noise model predictions to determine the requirements for noise mitigation
- Mitigation costs can easily amount to tens of millions of dollars on a single project
- It is therefore important to have reliable modelling results which adequately represent a project’s impacts and that correlate well with noise levels measured in the real world

Road Noise Prediction Inputs



Road Surface Correction: Current Practice

- It is not yet common practice for acoustic consultants to determine road surface corrections by measurement
- It is difficult to implement representative road surface corrections for projects with long alignments or on carriageways with variable surface types
- The usual method of modelling road noise is to apply 'standard' road surface corrections that are based solely on the pavement surface type in question.

Table 1: Example 'standard' road surface correction

Pavement surface type	Road surface correction (dB)
Dense graded asphalt (DGA)	0
Stone mastic Asphalt (SMA)	-2
Concrete	+3

- Noise models are typically calibrated/validated using noise monitoring data and concurrently measured traffic data. As a relatively small sample size of noise monitoring locations are typically used, there is potential for increased levels of random error.

Importance of Accurately Defining Surface Correction

- Majority of noise generated by road vehicles at speed is from tyre/surface interface
- Surface correction can change significantly:
  - With age. Deterioration over time exacerbated by:
    - Corners
    - Breaking areas
    - Percentage of heavy vehicles
    - Traffic volumes
    - Some surfaces are more susceptible to noise performance degradation
  - With chainage along a road (following works and maintenance)
  - Different road surface types may be laid in different sections of the same road:
    - Ramps
    - Corners
    - Declines
    - Speed changes
    - Bridges
    - Intersections
- An accurate definition of existing surface corrections is *essential* for:
  - Noise model validation
  - Determining the impact of the project and for mitigation design

How is Road Surface Correction Measured?

- Statistical Passby Method
  - Involves roadside measurements of vehicle passbys at a discrete location
  - Must be re-performed along an alignment to determine how the noise emissions vary along the alignment
- On-board vehicle measurement systems
  - Involves measurement of tyre-surface noise emissions from a vehicle in motion
  - Can measure road surface correction for a discrete area, or along a full road alignment

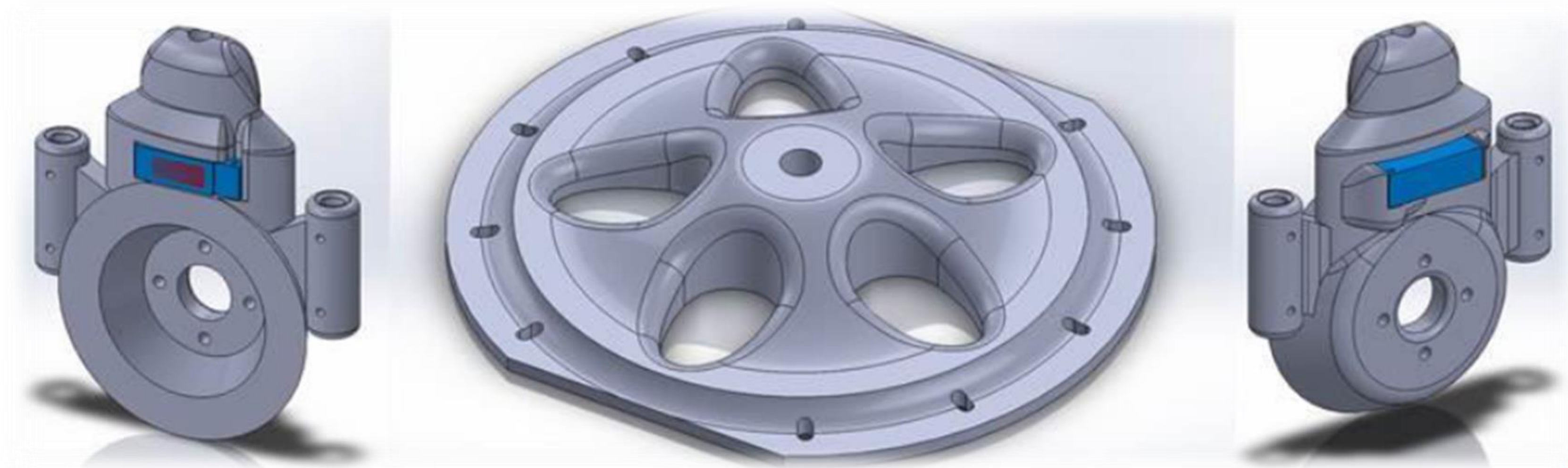
What is OBSI?

- On-board Sound Intensity (OBSI) is a method of measuring the noise generated at the tyre-surface interface of a moving road vehicle using microphones in a sound intensity probe configuration
- The OBSI measurement method and configuration is standardized (AASHTO TP-76)
- There are also other vehicle mounted test methods that the process and findings outlined in this presentation would likely apply to.

SLR

OBSI Measurement Configuration

- Brief description of SLR OBSI system
  - CAD designed and 3D printed / CNC componentry
  - High accuracy GPS in terms of both location and timing
  - Capable of spatial road surface results
    - Results per chainage
    - Results per lane
  - High accuracy speed measurement with integrated tacho
  - Heads up display for driver presenting vehicle speed with 0.1 km/h accuracy



OBSI Measurement Configuration

- System mounted to light passenger vehicle
- OBSI system can be easily fitted to various motor vehicle classes including:
    - Light Vehicles
    - SUVs
    - Light Rigid
    - Heavy vehicles
    - Trailers

A Noise Modelling Case Study Using OBSI

Measurement methodology, noise model inputs, and analysis

Unattended Noise Measurements

- Unattended noise monitoring adjacent to the M4 Motorway was undertaken at a number of locations by SLR on a recent road infrastructure project.
- This motorway is known to have an OGA pavement surface that varies notably in both age and condition.
- Nine noise monitoring locations were selected from the dataset. Locations were used that typically had unobstructed views of the main motorway carriageway and were not unduly affected by features such as being close to adjacent roads, near to garden fences, etc.
- Setback distances of the monitoring locations were typically around 20 m to 50 m from the carriageway.
- Traffic counting was undertaken concurrently.

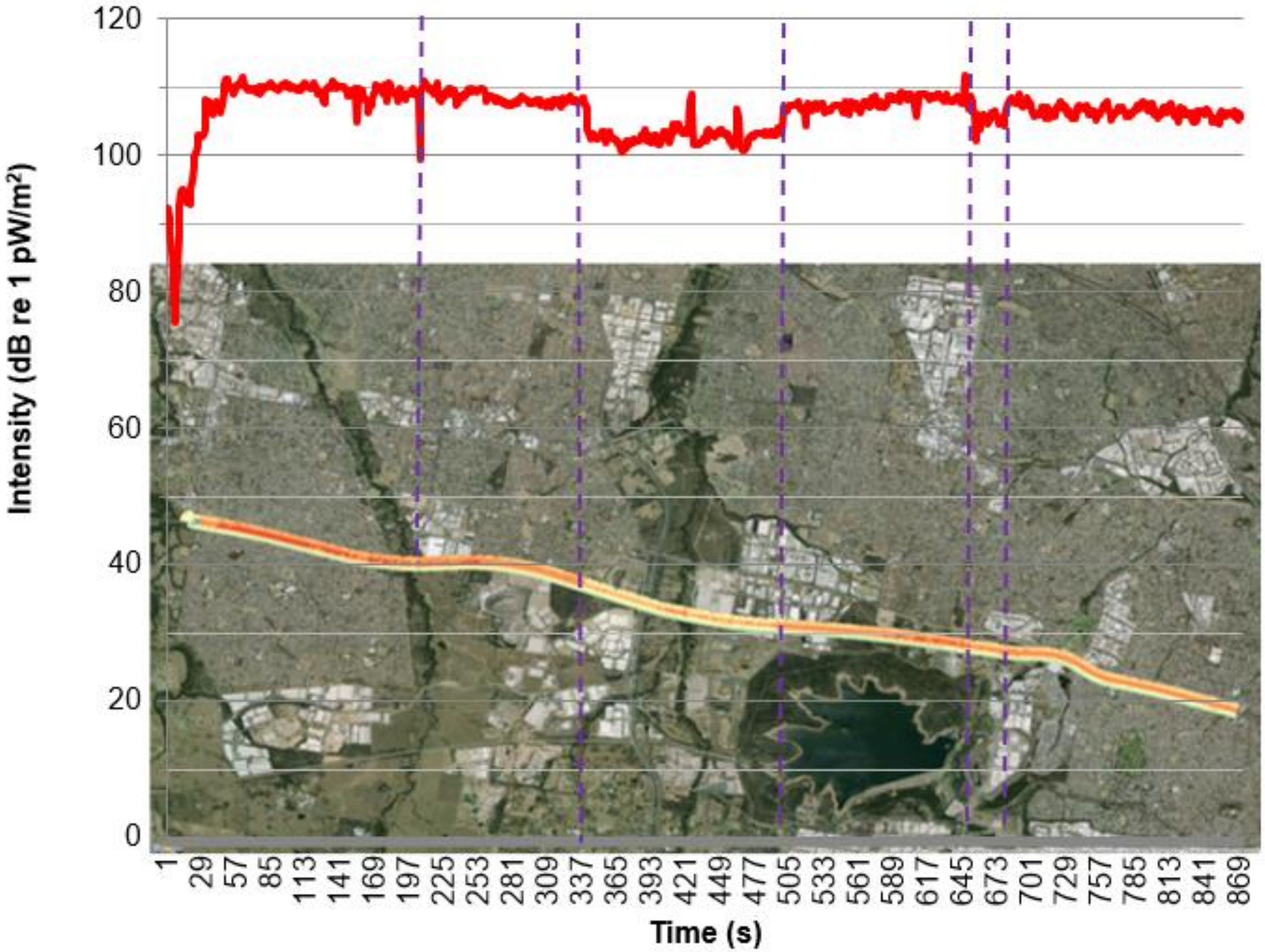
OBSI Surface Correction Measurements

- OBSI measurements of the M4 Motorway were undertaken by SLR to determine high resolution road surface corrections for the full length of the assessment area.
- Multiple OBSI measurements were completed in both the eastbound and westbound direction to allow an average for each carriageway to be determined.
- All measurements were performed with a vehicle speed of approximately 80 km/h.

Computer Noise Modelling

- Noise levels were predicted to the noise monitoring locations using a SoundPLAN noise model which implemented the Calculation of Road Traffic Noise (CoRTN, 1988) algorithms.
- Two scenarios were modelled
  - one making use of ‘standard’ road surface corrections (shown previously), and,
  - one using the high resolution OBSI measured surface corrections.
- Noise predictions were undertaken using free flowing traffic conditions.

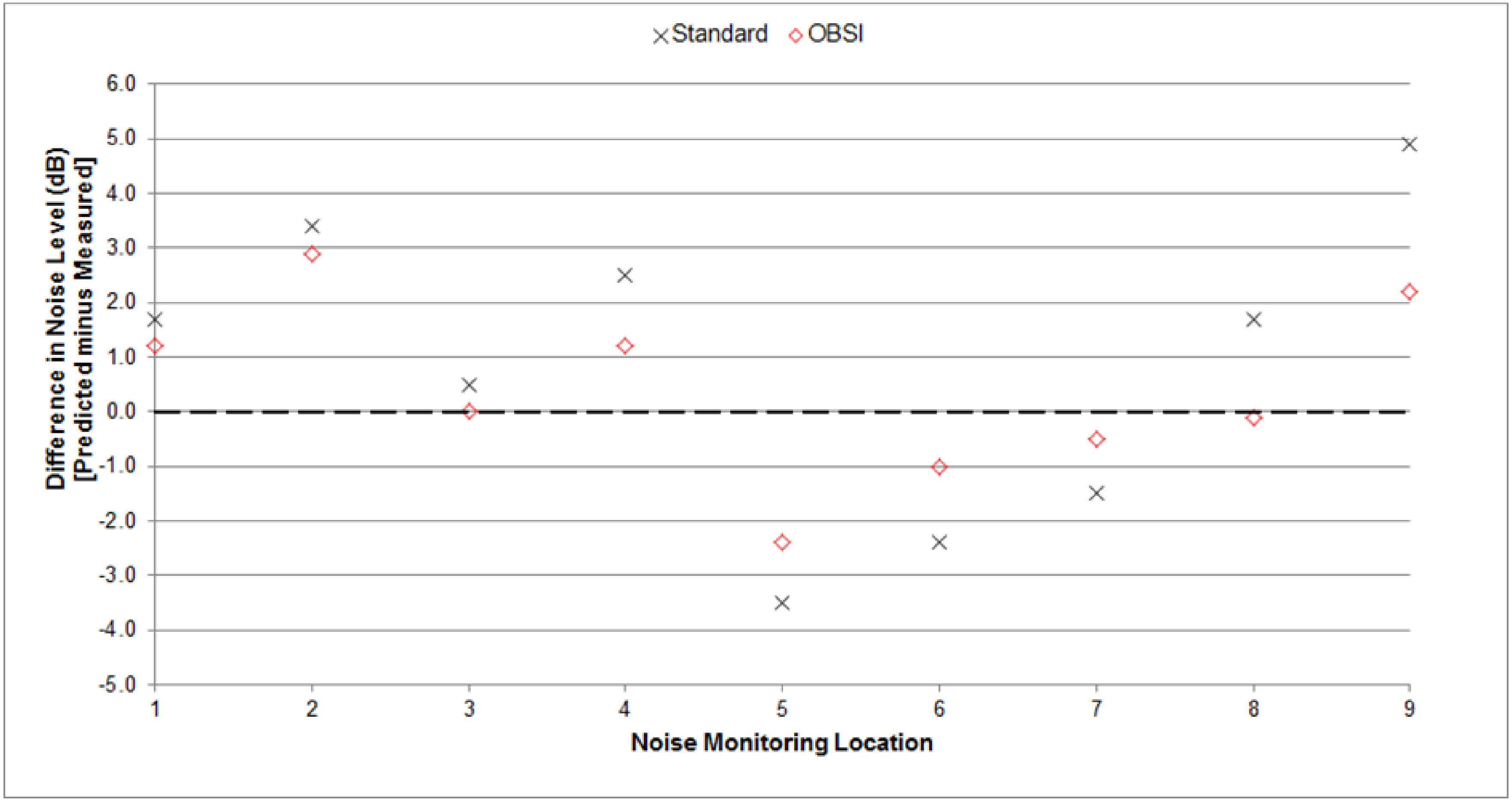
Surface Correction Measurement Results



Results

Noise Modelling Results Using ‘Standard’ and OBSI Corrections

Increased Model Accuracy with OBSI Corrections



Conclusions

- The results of the modelling show that the predictions which make use of the OBSI road surface corrections correlate better with the measured noise level data when compared to the scenario using ‘standard’ corrections.
- The OBSI corrections were found to improve both the median error and the standard deviation of the dataset.
- The median difference between Measured and Predicted was improved from:
  - +1.7 dB using ‘Standard’ Corrections
  - +0.0 dB using OBSI Corrections

Thank you for your attention!

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