IP4: Harnessing Disruptive Technologies for Earthquake Resilience

Nirmal Nair and Garry McDonald

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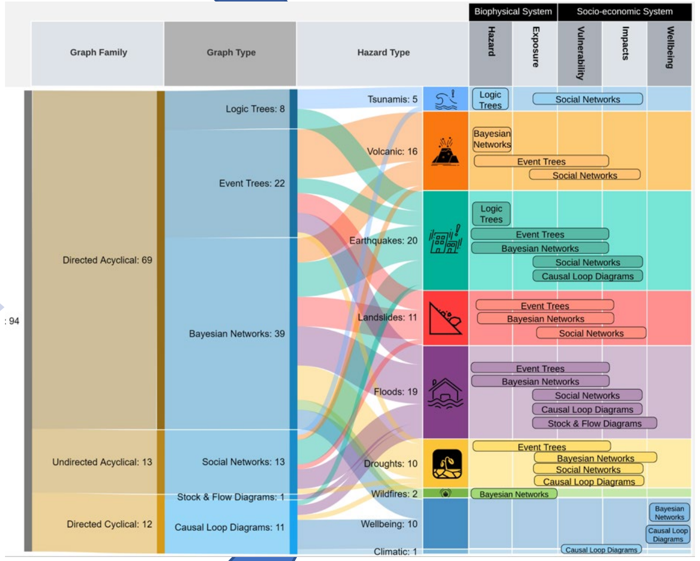
IP4 Structure



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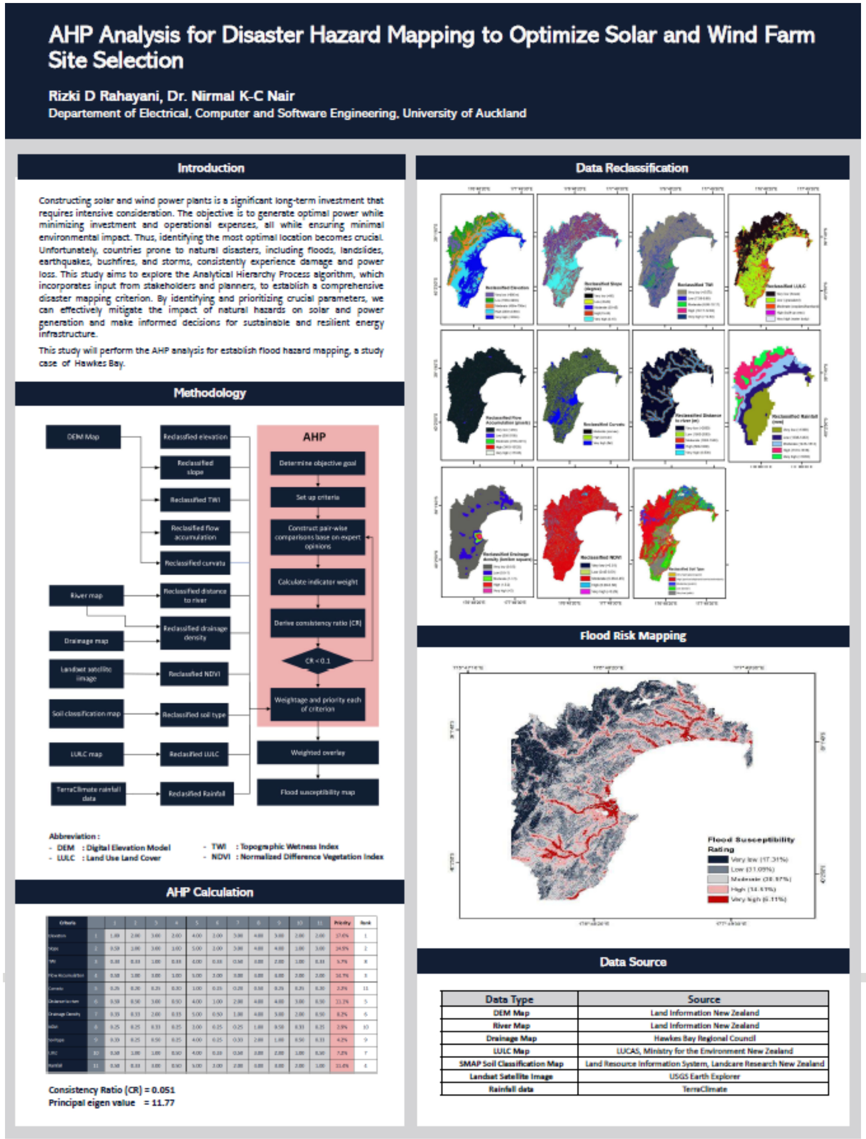
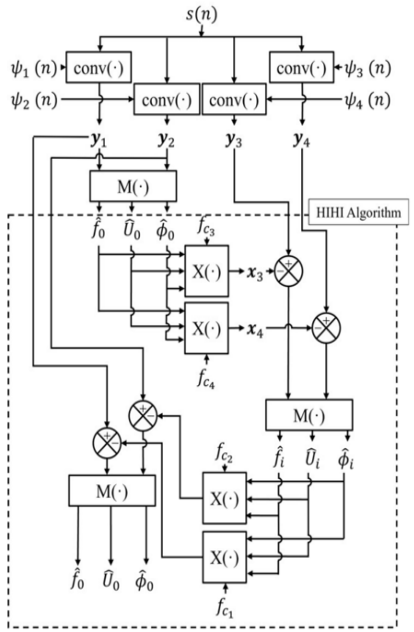
Renewable Distributed Energy

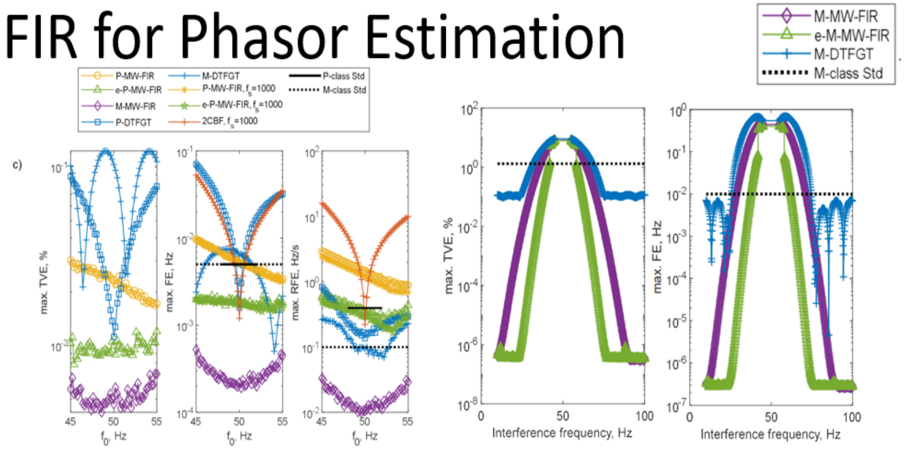


Liu and Nair in IEEE Transactions on Smart Grid (IF: 10.2)

Enhanced Morlet Wavelet-Based Two-Point FIR for Phasor Estimation



Block diagram of the proposed HIHI block.



Results: Summarizing the results of compliance tests, the enhanced P-class estimator outperforms the conventional version on almost all tests, and it has become a compliant P-class estimator. The OOBI efficiency for M-class estimators is improved by about 10 % and 20 % for TVE and FE, respectively.

These advanced instruments with accuracy, fast and robust phasor measurements in the distribution system could enable multiple applications, such as **situational awareness** in distribution grid, **early detection of network degradation pre-event**, identification of **failure hierarchy of a renewable distributed energy system**, etc.

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Smart Cities

- Text may contain useful location information about earthquake impacts.
- Mapping of these impacts is important for situation response.
- To map them, we need to know where they are.
- We use machine learning to detect whether text refers to a location *that can be mapped.*
- Location is more complex than just place name:
  - Tree down outside Orewa
  - Traffic congestion beyond the Bridge
  - People fleeing coastal areas across the city
  - Wellington responded to the situation in the North
- We have to consider the full expression to map accurately.
- We use multiple different contextual features for detection with accuracy of 90%.

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RESEARCH ARTICLE OPEN

Detecting geospatial location descriptions in language text

Kristin Stock[a], Christopher B. Jones[b], Shaun Russell[a], Mansi F
and Niloofar Aflaki[a]

P-wave-based S-Wave intensity estimation with PLUM detection to extend the warning window for Earthquake Early Warning

Student: Chanthujan Chandrakumar
Investigators: Raj Prasanna, Caroline Holden, Max Stephens Amal Punchihewa, Marion Lara Tan

Stage 1: Selection of P-wave Detection Algorithm

•Our project commenced with a thorough selection process to identify an optimal P-wave detection algorithm. This choice is crucial as it accurately identifies P-wave arrivals within seismic waveforms. [1][2]

•We assessed multiple algorithms, considering their performance metrics and capacity to handle diverse seismic data. This comprehensive evaluation guarantees the reliability of our subsequent analysis. [3][4]

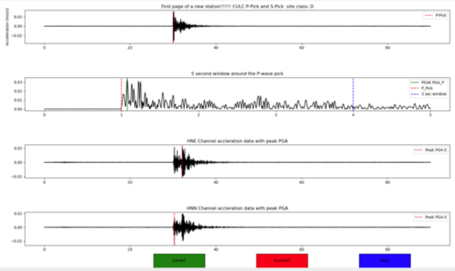

Figure 1: Our Custom-Built Tool P and S-wave parameter picking

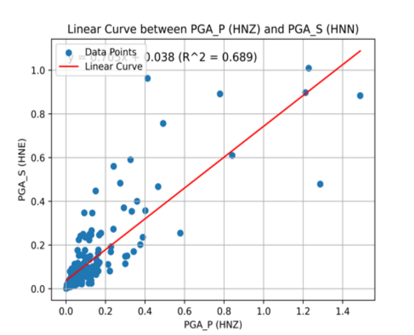

Figure 2: An empirical relationship built between the Peak Ground Acceleration of P and S-waves

Stage 2: Building a relationship between P and S-wave's intensity

•**Data Source Selection:** Our study is centred on CUSP stations in Canterbury (2015-2022) with labelled P-wave picks, ensuring robust data quality.

•**Waveform Collection:** From the selected stations, we acquired 3085 waveforms, forming a substantial dataset for analysis.

•**P-wave and S-wave Parameters:** Extracted key parameters within three seconds of P-wave arrivals and during the S-wave using a tool (Figure 1) developed by the research team.

Relationship Building: Our ongoing work involves correlating the extracted parameters, and building an empirical relationship between P-wave and S-wave intensities (e.g., Figure 2).[5]

Modelling and Evaluation

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ELSEVIER

Review

A review of graphical methods to map the natural hazard-to-wellbeing risk chain in a socio-ecological system☆

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systems MDPI

Article

Towards a Dynamic Equilibrium-Seeking Model of a Closed Economy

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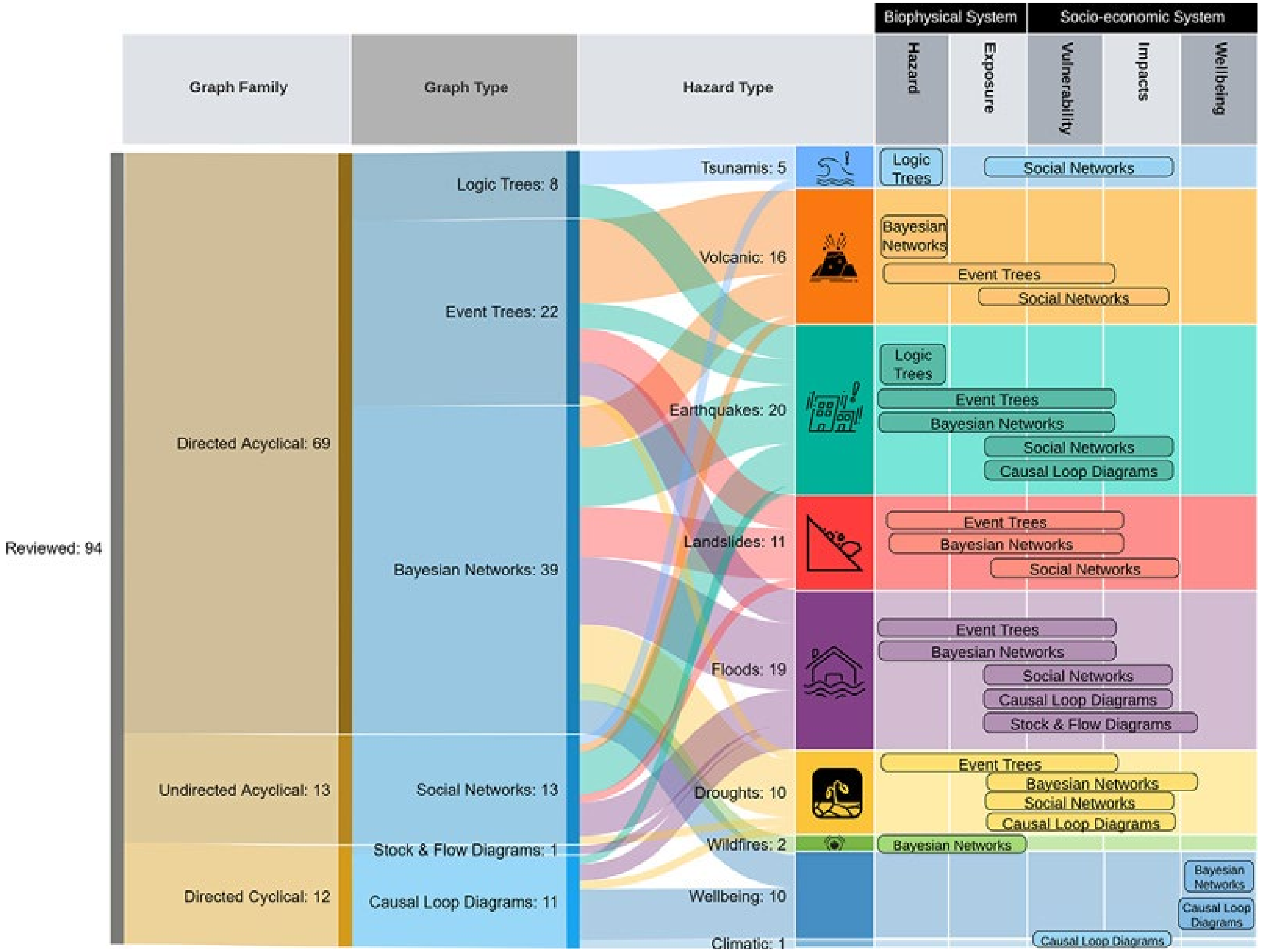
EARTHQUAKE SPECTRA

Using an integrated dynamic economic model to support infrastructure investment decision-making

Charlotte Brown,[a)] M.EERI Nicola McDonald,[b)] Garry McDonald,[b)] Michele Daly,[c)] Erica Seville,[a)]



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Key Challenges

Expanding Associate Investigator (AI) and Early Career Researcher capability through aligned opportunities and research programmes

- Jun 2023 IP4 Annual Meeting
- Establishment of QC Artificial Intelligence Group
- Running conferences to better connect researchers with stakeholders
    - Nov 2022 eGRID – 7th IEEE Electronic Grid conference
    - Nov 2023 ISGT – 12th IEEE PES innovative smart grid technologies conference
- Grant writing workshops for Endeavour Smart Ideas (4 applications x 2 AI's, $1m grants)

Endeavour Programmes

He Moungа Puia, Puea Ru, Puea Korero
volcanicfutures.co.nz

[1] Transitioning Taranaki to a Volcanic Future
$16m, 2019-24
McDonald & Cronin

[2] Future Coast Aotearoa
$16m, 2021-26
Stephens, McDonald, et al.

[3] Adapting to Climate Change through Geothermal Enterprises
$8m, 2022-27
Cronin & McDonald

National Science Challenges

RESILIENCE TO NATURE'S CHALLENGES | Kia manawaroa – Ngā Ākina o Te Ao Tūroa
National Science Challenges

[1] Multi-hazard Risk Model
$4.5m, 2019-2024
Bebbington & McDonald

Questions