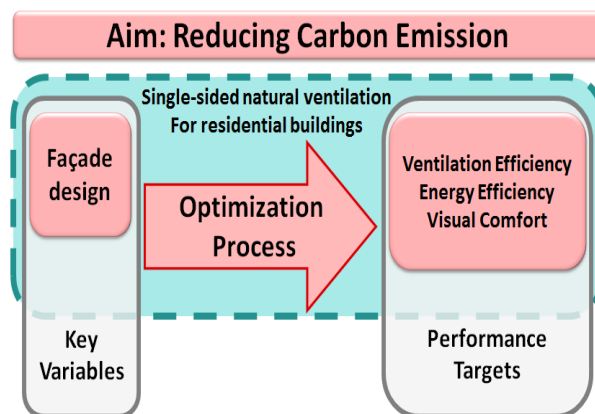# AN EVOLUTIONARY APPROACH TO SINGLE-SIDED VENTILATED FAÇADE DESIGN

RESEARCH QUESTION

How can single-sided façade design be optimised to decrease energy consumption and improve indoor environment while not adding to carbon emission?

How can a high-level and innovative façade optimization algorithm be developed to investigate the best façade designs?

Aim: Reducing Carbon Emission

Single-sided natural ventilation For residential buildings

| Façade design | Optimization Process | Ventilation Efficiency Energy Efficiency Visual Comfort |

Key Variables — Performance Targets

SCOPE

Residential
Sydney
Mid-rise
**SCOPE**

METHODOLOGY

An Evolutionary Process Model based on Genetic Algorithm (GA)

EnergyPlus is used to evaluate the performance targets, and Matlab is used to run the evolutionary process.

Competition
Competition for achieving the highest fitness functions and creation of new design options

Genetic Search Space
(Single-sided Façade Key Design Variables)
- Openings
- Balconies
- Shadings
- Construction
- Neighbour units

Multi-objective Performance Space
(Fitness Functions)
- Ventilation Efficiency
- Energy Efficiency
- Visual Comfort

Pareto Fronts

Optimal solutions
Optimal solution for single-sided façade design

Discovery
Discovery of the relationship between key variables that map onto the high finesses of the three performance outcomes

BY USING THE EVOLUTIONARY MODEL, WE CAN DESIGN LOW CARBON, COMFORTABLE AND HEALTHY RESIDENTIAL BUILDINGS

RESULTS

The final result of this optimization will be a set of optimal façade designs all satisfying the objectives of natural ventilation efficiency, energy efficiency and visual comfort in the acceptable range.

A MULTI-DISCIPLINARY RESEARCH

Mechanical Engineering
Artificial Intelligence
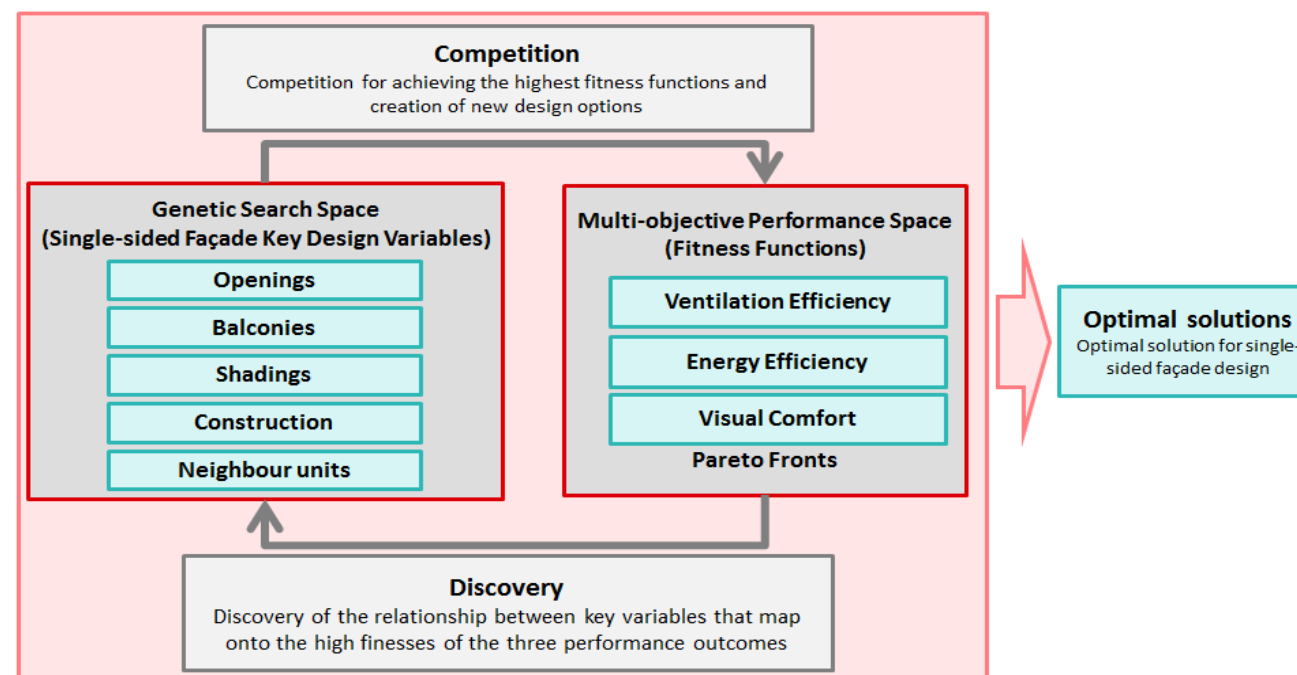Architecture
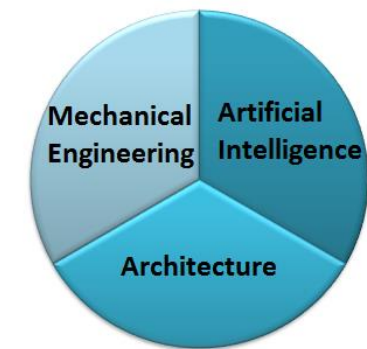
CONCLUSION

• *An evolutionary method which can be used by architectural practices to optimize façade designs*

• *A set of optimal façade designs which map onto high performance of natural ventilation efficiency, energy efficiency and visual comfort*
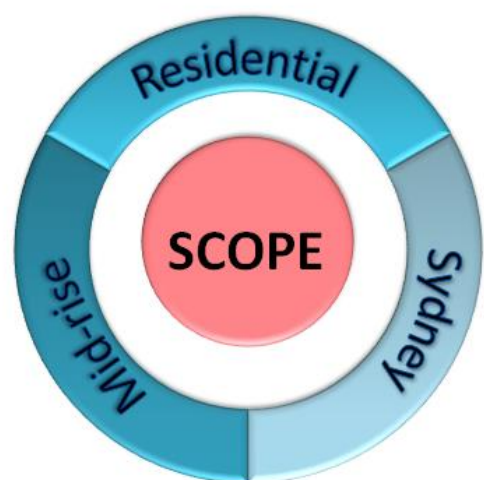
ANTICIPATED IMPACTS

• *Design support for single-sided ventilated façade design*

• *Decreasing carbon emission in residential building sector*

FURTHER INFORMATION CONTACT

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