Feasibility of a Push-Through Hyperloop Airlock Architecture

Samuel Muirhead, Dr Stephen Connolly[1]

1. Department of Mechanical and Aerospace Engineering, University of Strathclyde, Glasgow,G1 1XQ

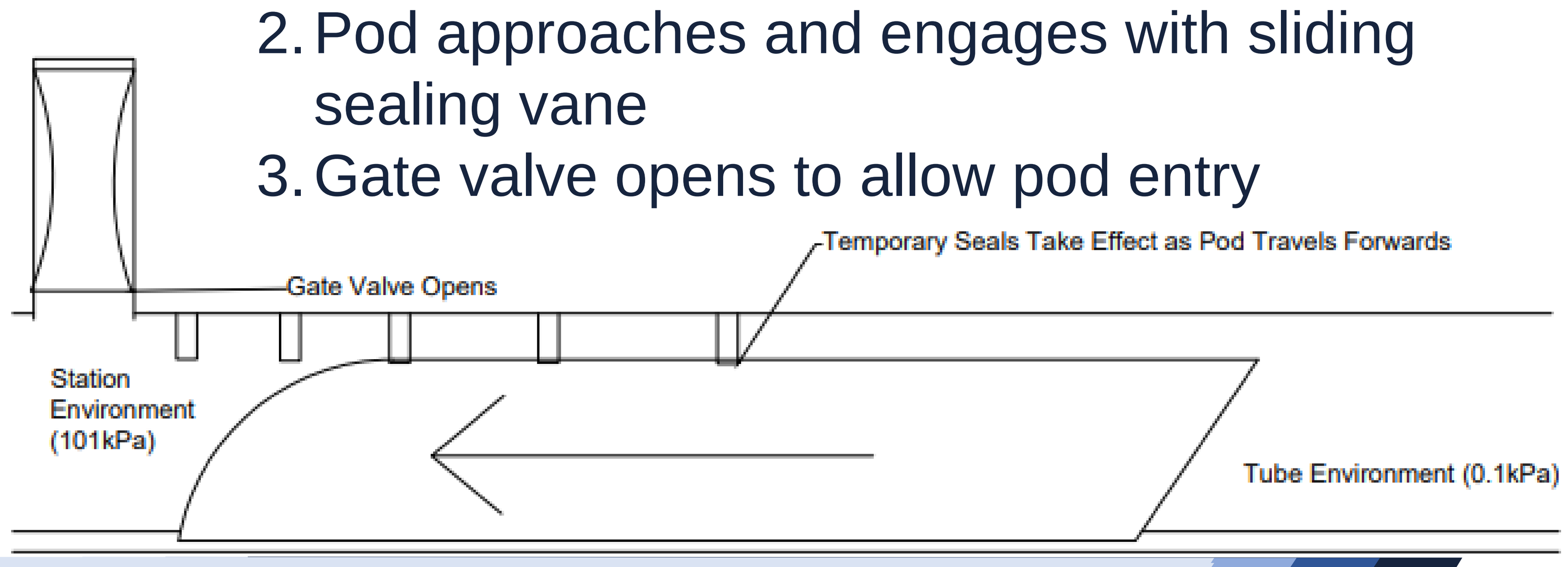
University of Strathclyde Glasgow

1. What is Hyperloop?

Proposed future mode of transportation which combines magnetic levitation and vacuum tubes to sustainably move people and cargo at speed of up to 1000 kmh.

2. Push-Through Airlock

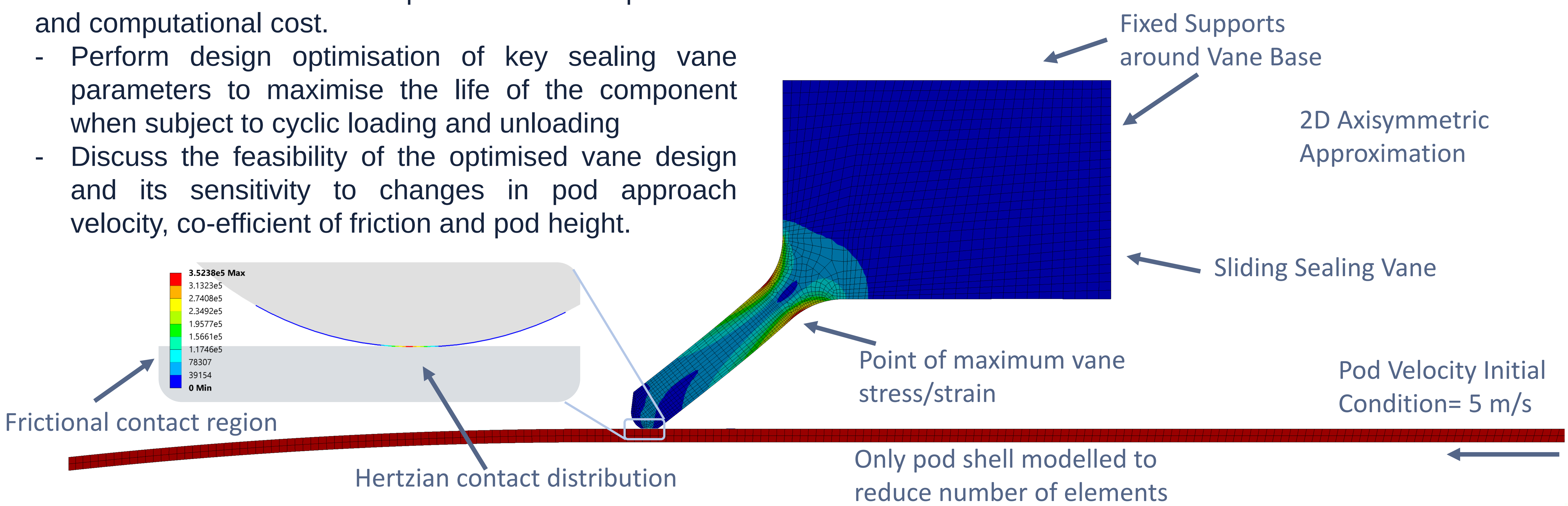
1. Gate Valve creates permanent seal between low pressure tube and station
2. Pod approaches and engages with sliding sealing vane
3. Gate valve opens to allow pod entry



3. Project Goals

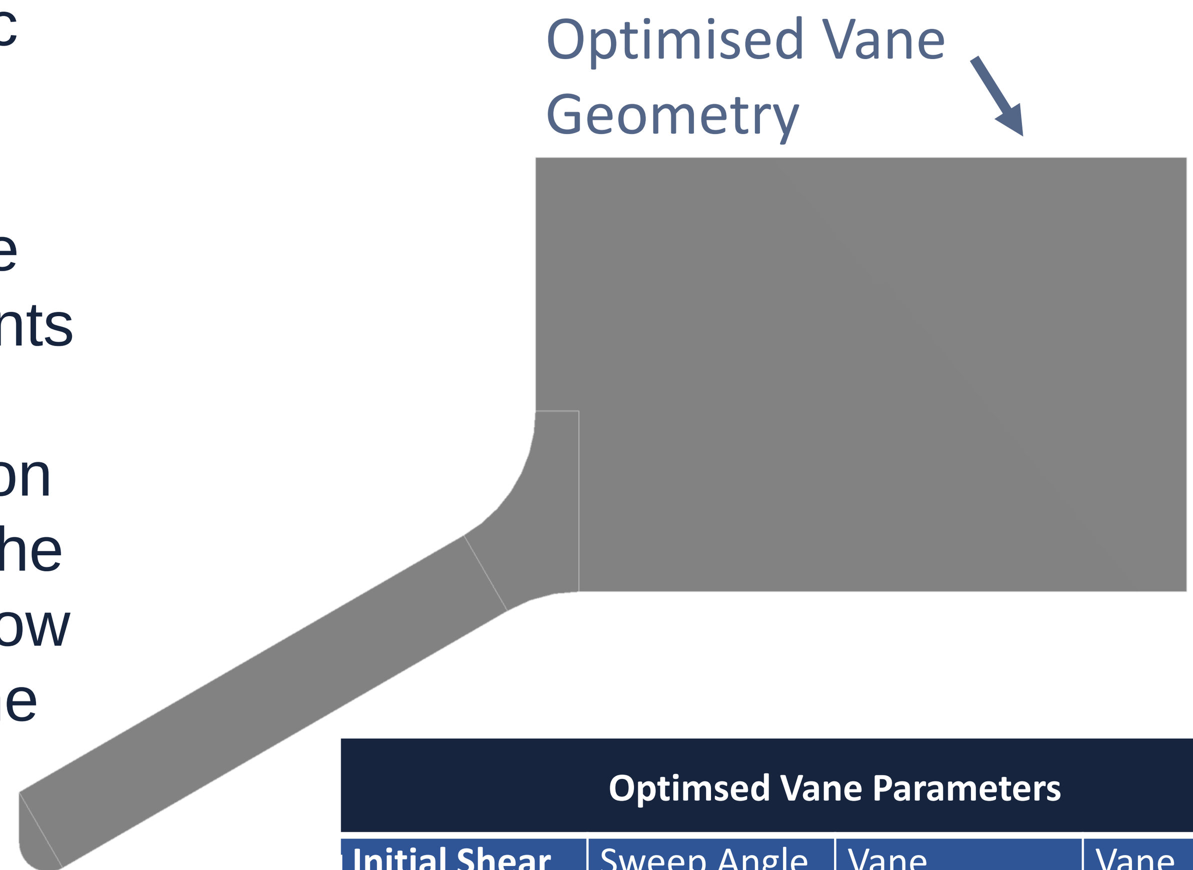
- Further develop a finite element mathematical model to simulate the interaction between a Hyperloop pod and a sliding sealing vane in a Push-Through airlock.
- Compare implicit and explicit formulations and determine which method is superior in terms of precision and computational cost.
- Perform design optimisation of key sealing vane parameters to maximise the life of the component when subject to cyclic loading and unloading
- Discuss the feasibility of the optimised vane design and its sensitivity to changes in pod approach velocity, co-efficient of friction and pod height.

4. Finite Element Model

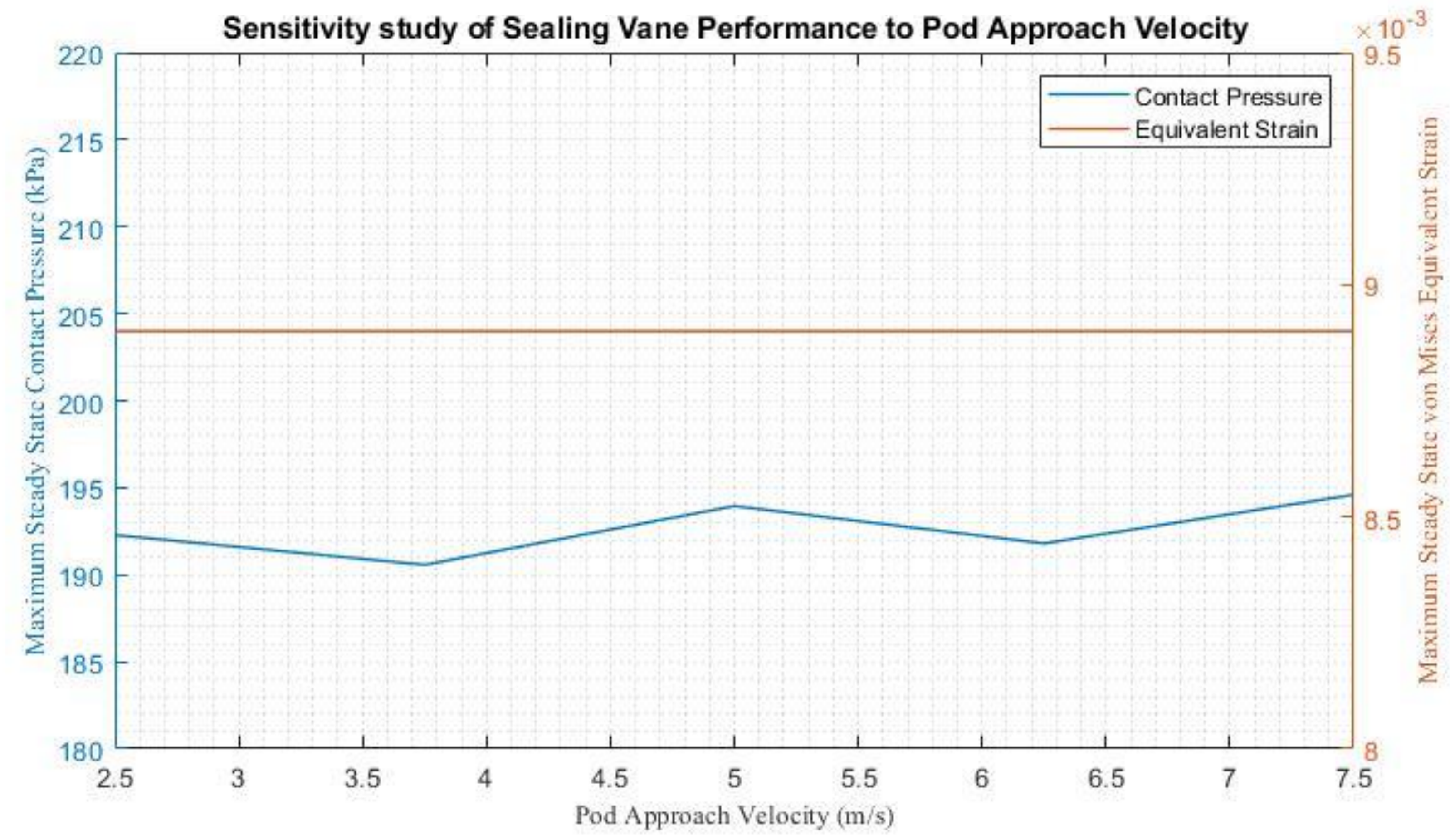


5. Design Optimisation

A composite cubic design of experiments was produced, and the resulting data points were used in a MOGA optimization algorithm to find the best solution. Below is the results of the optimization.



Optimsed Vane Parameters			
Initial Shear Modulus	Sweep Angle	Vane Compression	Vane Thickness
4.7521 MPa	120 degrees	2.2348 mm	10.06 mm



The optimised vane design was tested at different pod velocities to check the performance. In the figure above, the performance variables showed almost no change, proving its robustness.

6. Project Outcomes

- Due to incompatibilities with contact pressure results, implicit finite element solution was chosen for the analysis.
- Optimised vane 185% more effective in providing the required 200 kPa contact pressure.

7. Future Work

- Utilize the new value of strain to create an estimate of fatigue life of the vane component.
- Analyse the effects of abrasion on the rubber vane surface over the life-cycle of operation
- Develop the mathematical model to factor in 3D circumferential effects.

The Carnegie Trust for the Universities of Scotland

STRATHLOOP