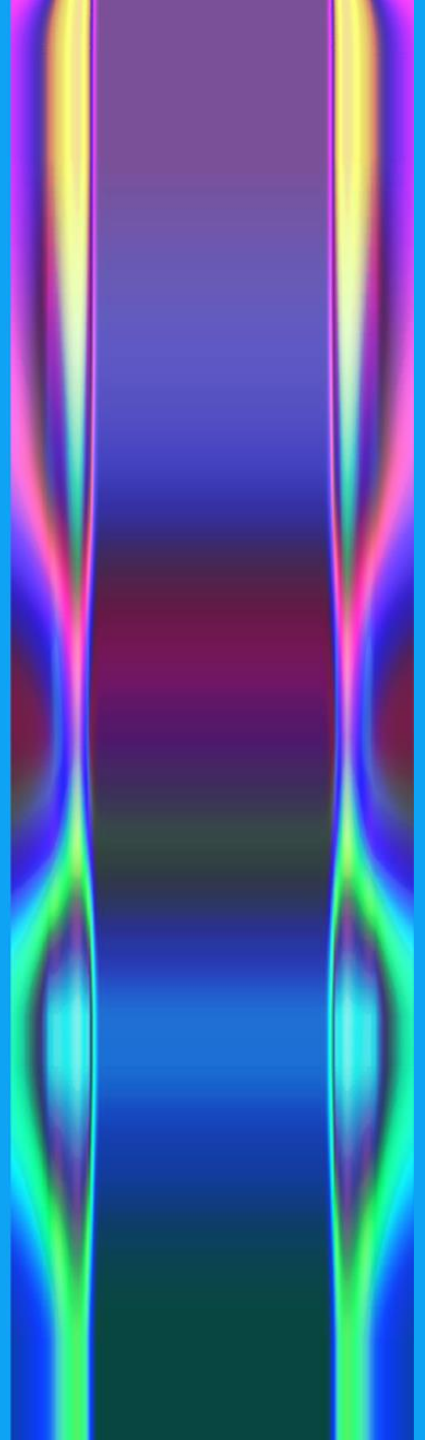
Ciaran Haines

Lead Data Scientist

Esoterix



UKRI Innovate UK BridgeAI

techSPARK* bristol

CAT

Crowding Alert Technology

near-casting train occupancy while respecting disruption

Ciaran Haines

The agenda

- Priorities
- Crowding
- Technical data
- Our data
- Public info
- Our goals
- SOTA
- Time Series
- Network
- Outcomes
- Next Steps
- Questions

Side notes are included throughout to indicate some opportunities in this field

Ciaran Haines

Escterix

Part 1: What is the challenge?

Ciaran Haines

"What's the important factor in overall satisfaction?"

1. Punctualtiy 16%
2. **Crowding** 10%
3. Cleanliness 9%
4. Length of scheduled journey 8%
5. **Information on how busy the train would be before travelling** 7%

...

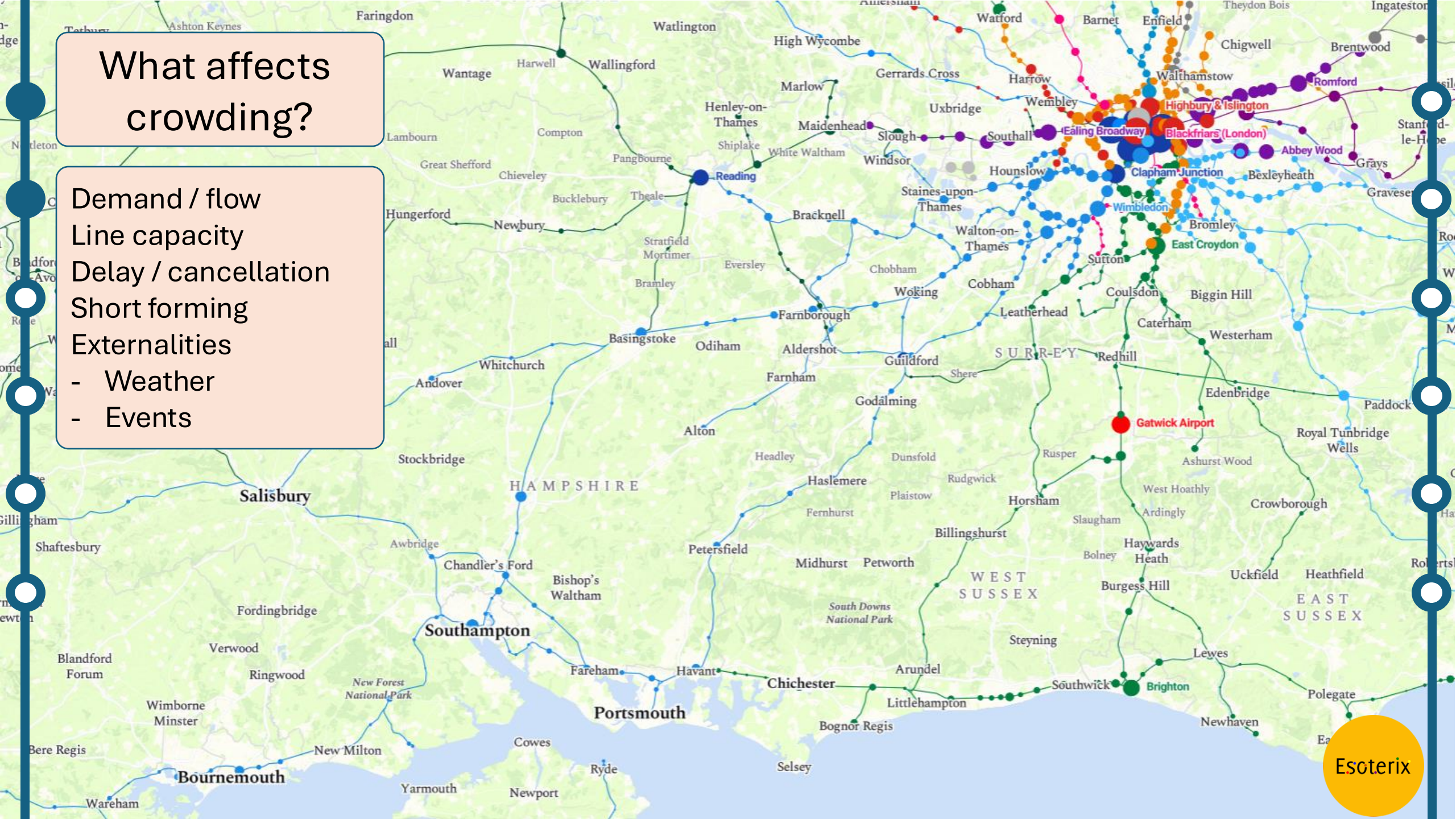
Transport Focus, Rail User Survey

Passengers want more space and better information

Escterix

What affects crowding?

Demand / flow
Line capacity
Delay / cancellation
Short forming
Externalities
- Weather
- Events

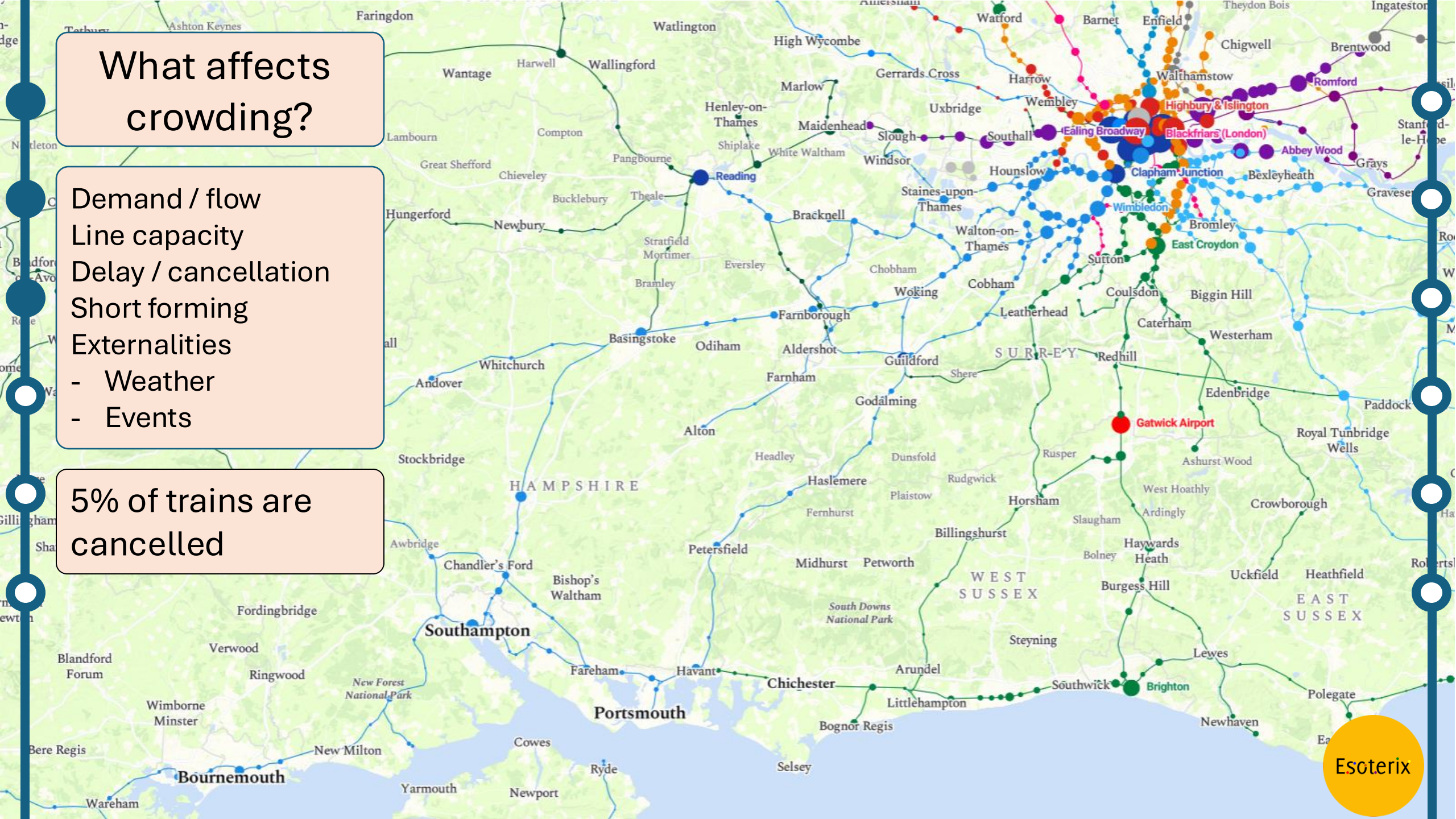


Escterix

What affects crowding?

Demand / flow
Line capacity
Delay / cancellation
Short forming
Externalities
- Weather
- Events

5% of trains are cancelled



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Technical Data

Darwin data feeds details

LDB Webservice (PV) +

LDB Webservice (Staff Version) +

Darwin Timetable +

Darwin Push Port —

Feed Type: Push Feed

Licence: NRE OGL

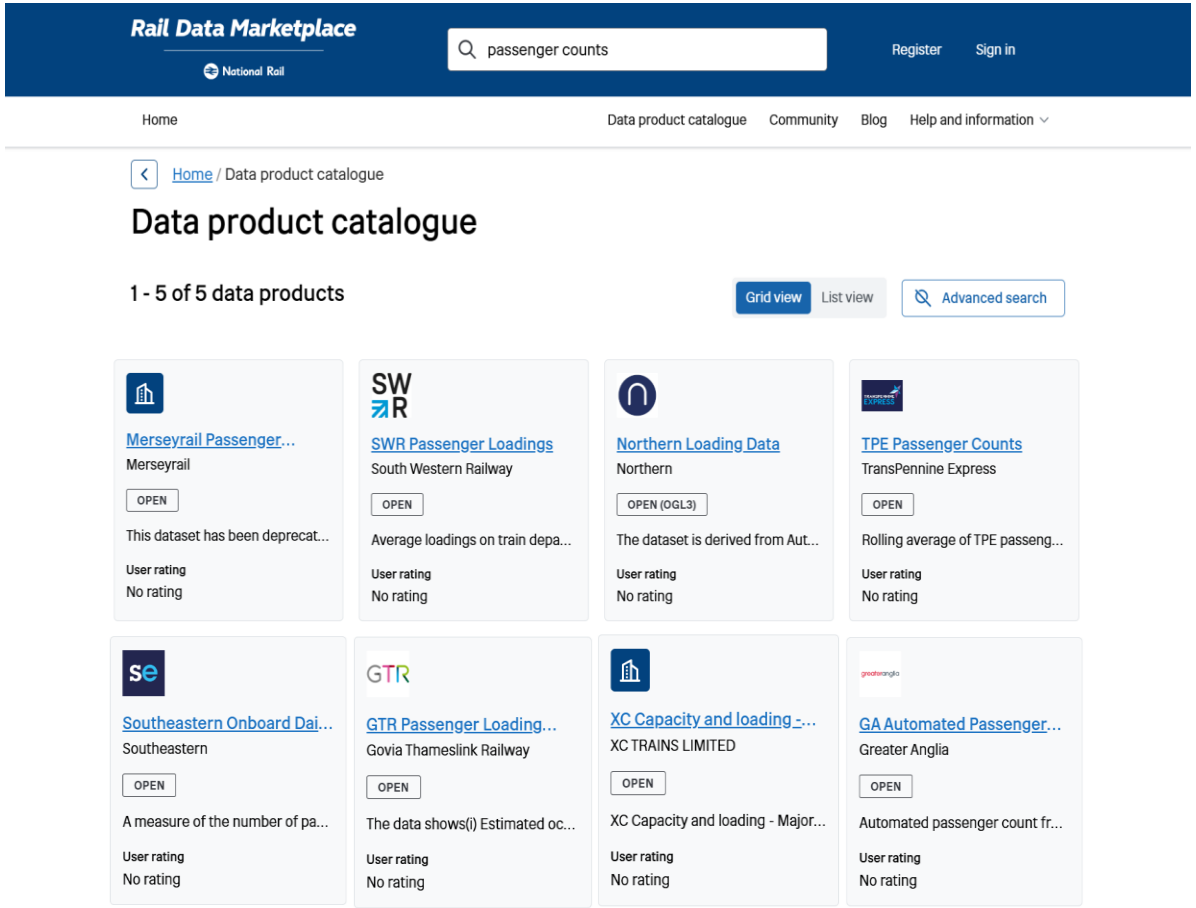
User Guidance: Darwin Push Port

Sign Up: Rail Data Marketplace

Historic Service Performance (HSP) +

Darwin live timetable data is very fast and large.

Problems: overlapping updates, duplication, missingness, volume!



Train crowding data can be accessed on the Rail Data Marketplace

Problems: Old (historic), average service load, irregular updates...

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Our Data

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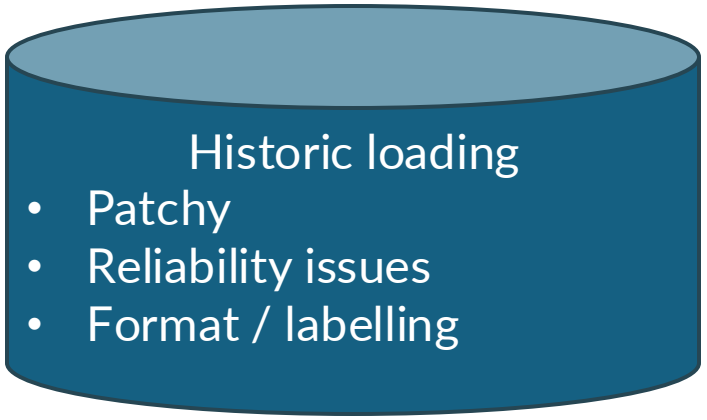

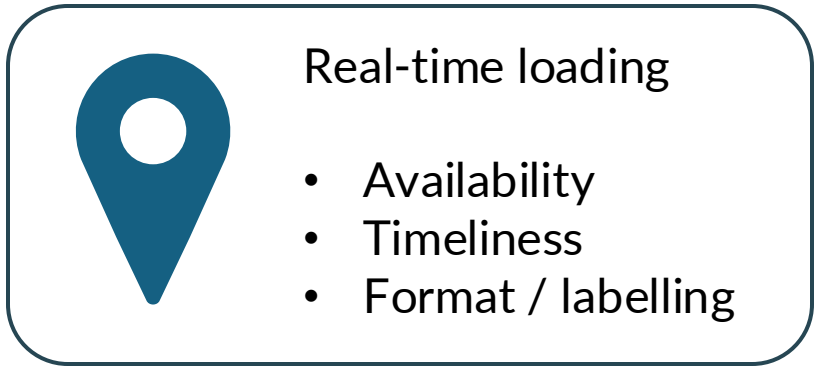

Raw Data Sources

Train based or Station based – affects model choice.
This is a developing area without community standards.

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Public Info

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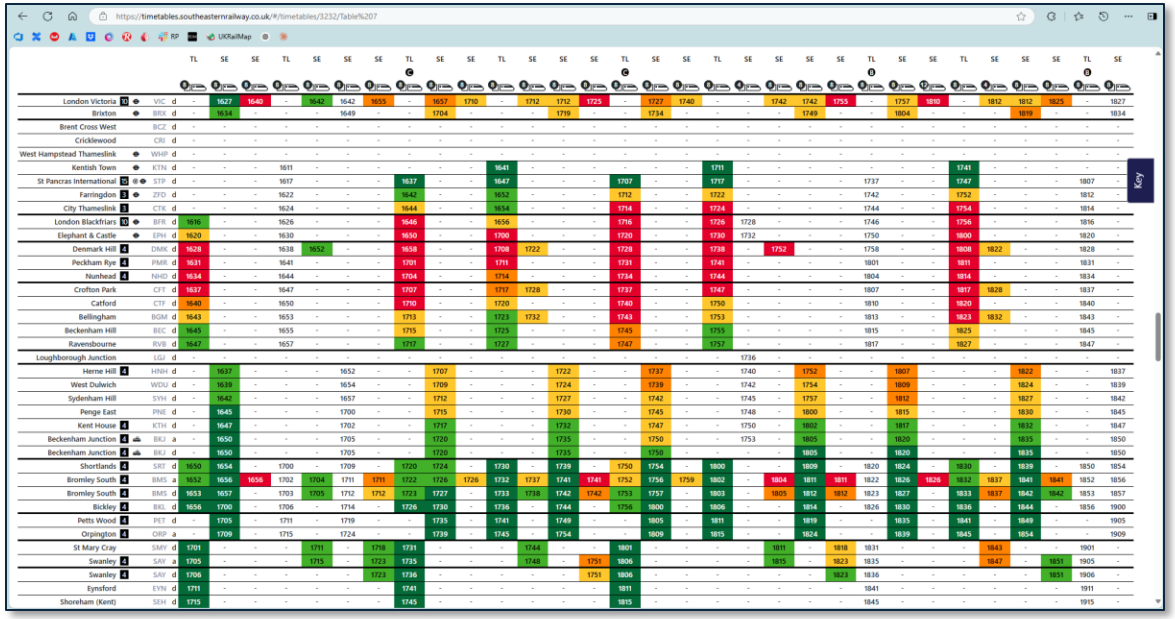

Woking to London Waterloo

Arriving before 10:00 AM

Move left and right to view the full table ⟷

Departure	Arrival	Via	Planned number of carriages	Seat capacity		
06:28	07:04	-	8	Tuesday Seats available	Wednesday Seats available	Thursday Seats available
06:32	07:24	-	8	Tuesday Seats available	Wednesday Seats available	Thursday Seats available
06:37	07:09	-	8	Tuesday Seats available	Wednesday Seats available	Thursday Seats available
06:41	07:28	-	8	Tuesday Seats available	Wednesday Seats available	Thursday Seats available
06:47	07:21	-	5	Tuesday Some seats available	Wednesday Some seats available	Thursday Some seats available

Later services

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Our goals

Crowding Alert Technology

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Our goals

Crowding Alert Technology

April to September 2024

Solution Research & design
MVP predictor development
Field Trial – live timetable data, historic loading
Predictor improvements
Further field trial

Innovate UK KTN

Innovate UK BridgeAI

Empowering UK organisations to harness the power of AI through support and funding, bridging the AI divide for a more productive UK.

South Western Railway

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- Priorities
- Crowding
- Technical data
- Our data
- Public info
- Our goals

Part 2: Our Project

- SOTA
- Time Series
- Network
- Outcome
- Next Steps
- Questions

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State Of The Art

Crowding forecasts

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State Of The Art

Transport volume forecasts

Rolling Averages / ARIMA
Network / graph science
Machine Learning
Deep learning

Google: “Busier than usual”

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State Of The Art

Transport volume forecasts

Rolling Averages / ARIMA
Network / graph science
Machine Learning
Deep learning

Google: “Busier than usual”

Similar problems in academia are mostly for Road Traffic forecasting

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Time Series Data View

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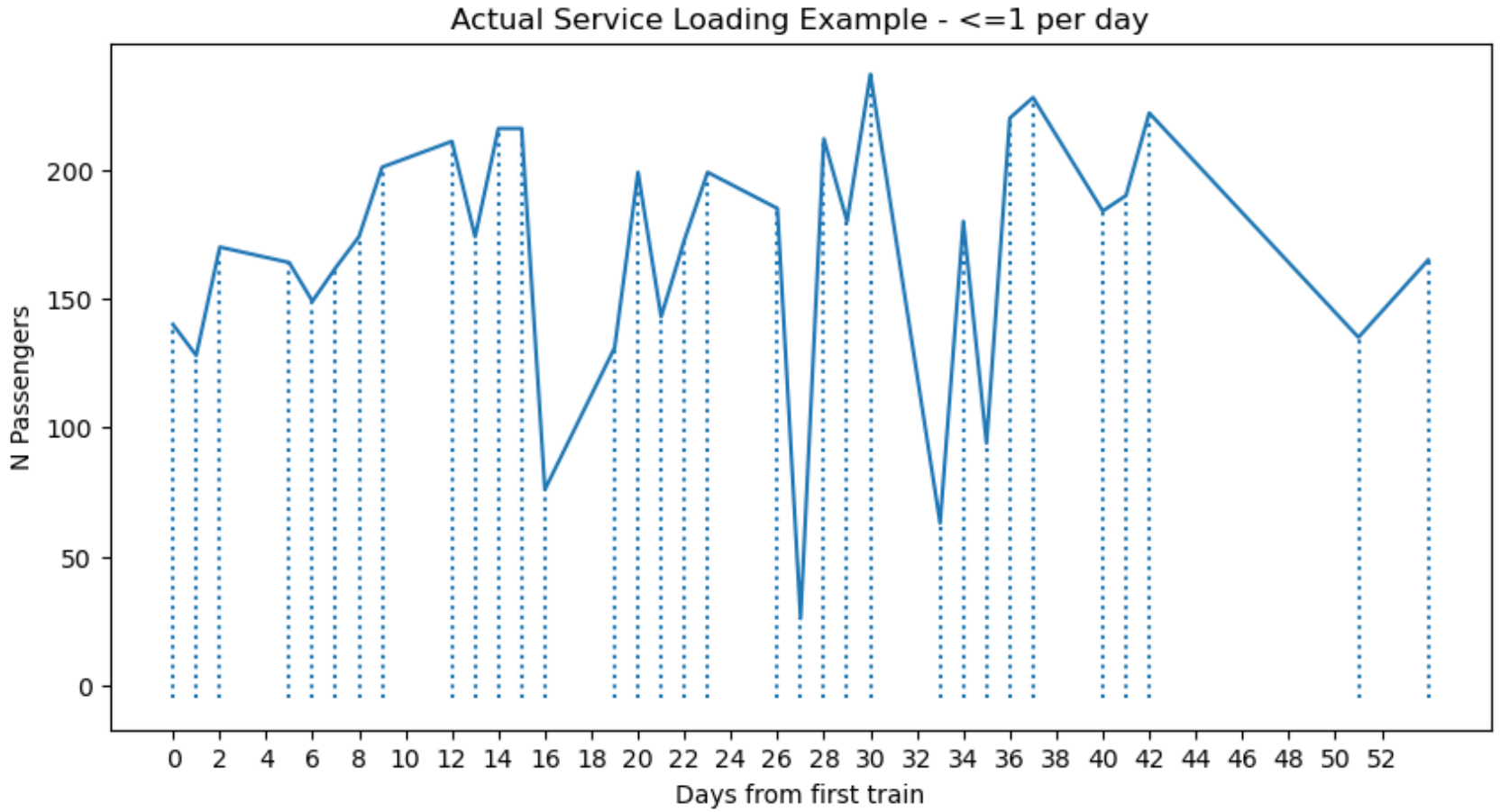
Time Series Data View

Service history - sparse 1 per day – can ignore times – very legitimate



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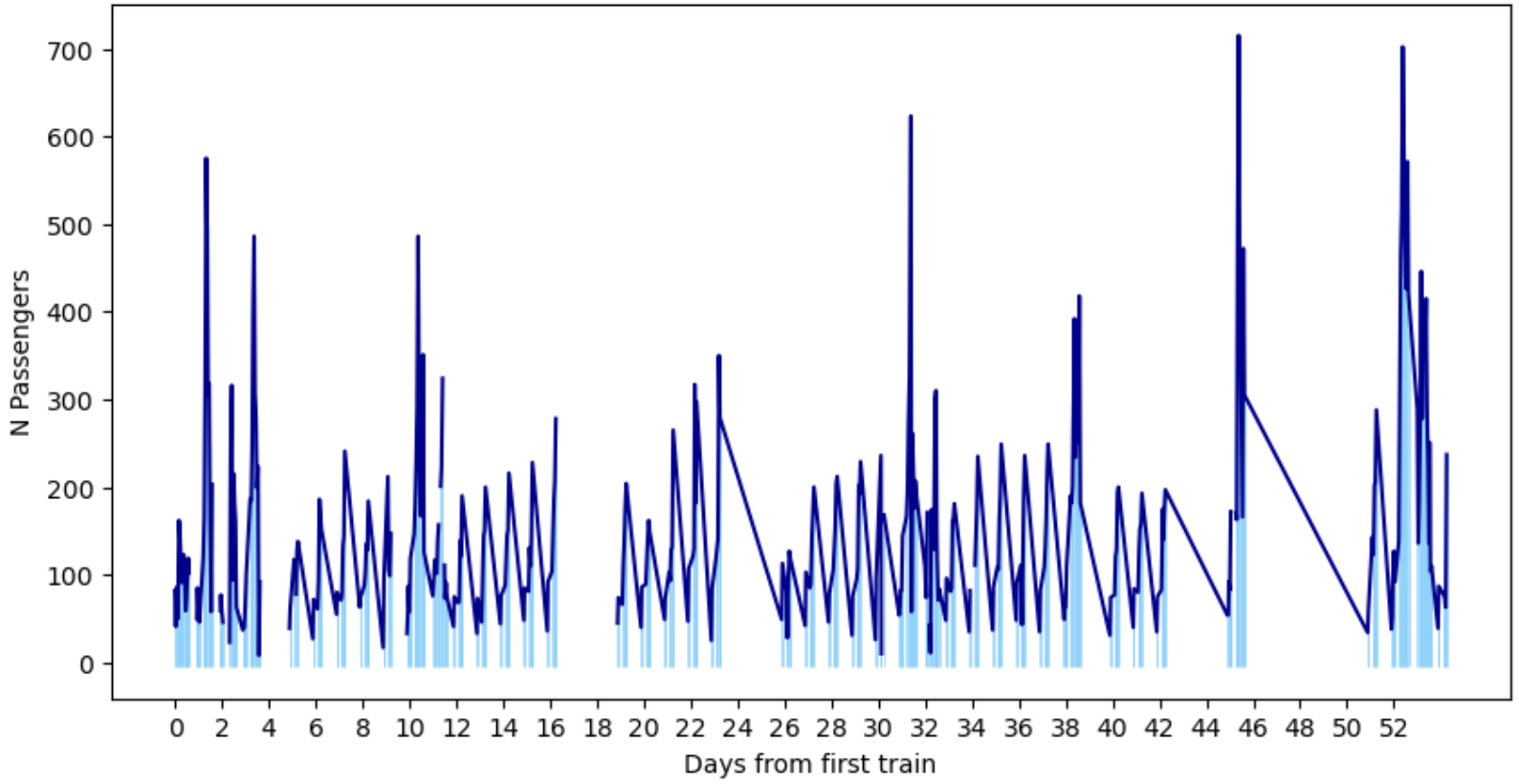
Time Series Data View

Line history - adds data/variability - irregular timings - time indexing?



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Time Series Data View

Other aggregation

- Could combine multiple lineIDs
- Irregular timings
- Inconsistent destinations – “network effects”
- More data

- Adds legitimacy issues

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Network Data View

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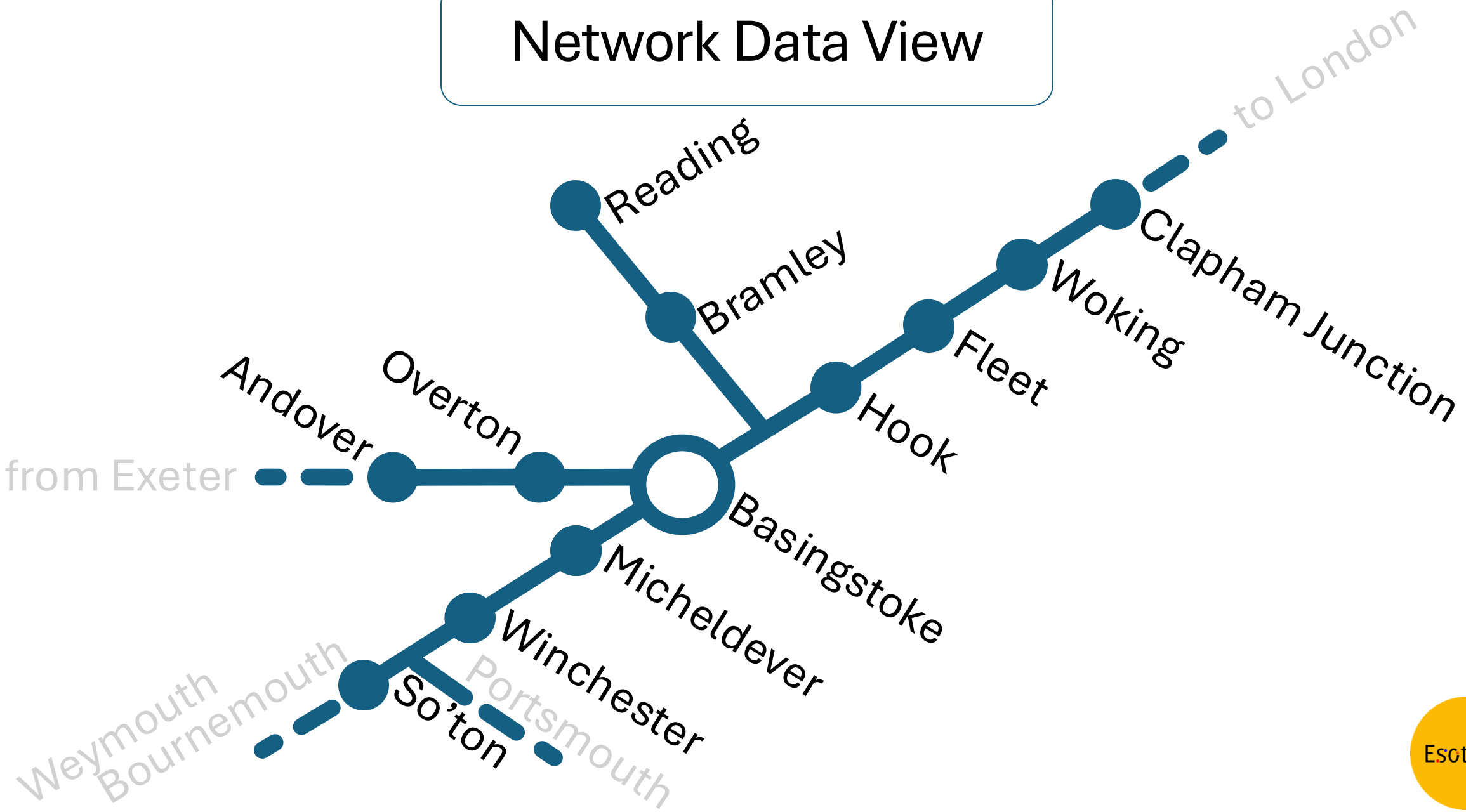
Network Data View



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Outcome

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Outcomes

Successfully predicting around delay

Successfully predicting around cancellations

Improved performance vs industry standard

Multiple predictors developed

Useful horizon times (and flexible to change!)

Further development in progress...

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Next Steps

Currently

- Running ML model C.A.T.
- Gathering assessment data

Further model development

- GNN modelling for better network capture

Review outputs

- Additional customer type adaptation
- Varying output – passenger load vs alerts
- Explainable outputs – causal alerts?

Preparing to publish a product on the Rail Data Marketplace!

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Questions?

To discuss, please contact

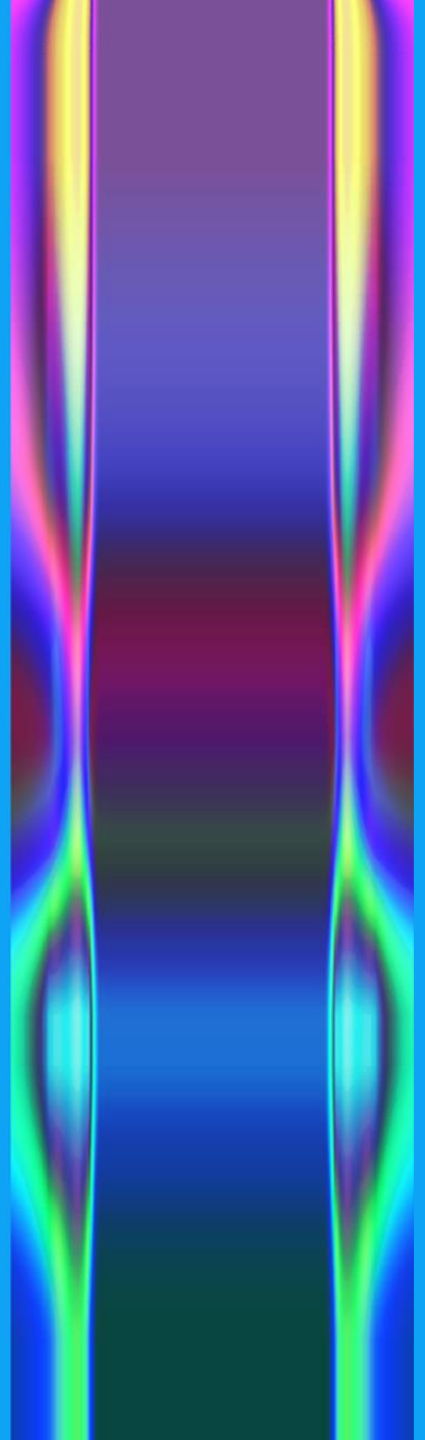
Ciaran | ciaran.haines@esoterix.co.uk

Esoterix

Jody Muelaner

CEO

Better Bicycles Ltd



UKRI Innovate UK BridgeAI

techSPARK* bristol

BriefBike: A folding bike that makes cycling more convenient

Ant Design Solutions 2025

- Folds as easily as an umbrella
- Stores flat against a wall
- Easy roll-along when folded, even with bags attached

Cycling key to green growth & health, yet cars are compelling

Electric cars don't stop this

Air pollution kills 7 million people every year[1] (4x Covid). 55% of particulate pollution comes from tyres and brakes[2]

E-scooters aren't active

Activity related health from the Netherlands' cycling culture boosts GDP by 3%[3]

People want to cycle more

48% of urban UK adults want to cycle more, only 9% cycle regularly[4]

1) World Health Organization, 'Air Pollution', 2022
2) Committee on the Medical Effects of Air Pollutants, 2018
3) American journal of public health, 'Dutch Cycling: Quantifying the Health and Related Economic Benefits', 2015
4) Sustrans, Bike Life UK Report

A more convenient bike, to make fun, healthy, sustainable travel the easy choice

Effortlessly flicks open in 0.5s

20x faster than competition and do it without bending

Stores flat on wall

68% thinner & 48% less volume than a Brompton

Rolls easily folded

Like a roller case, arm in tension and wide base

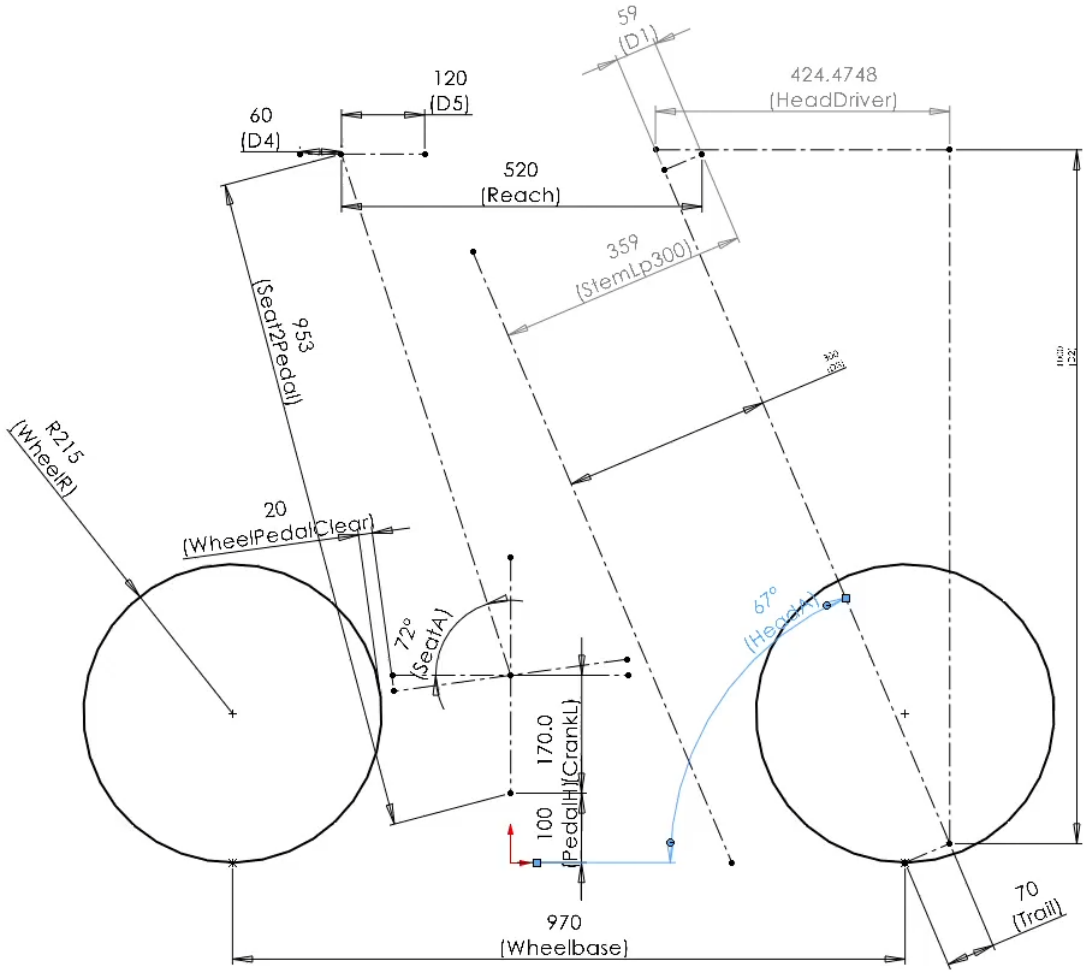
Carry child or cargo

Rolls easily when folded with bags or trailer attached

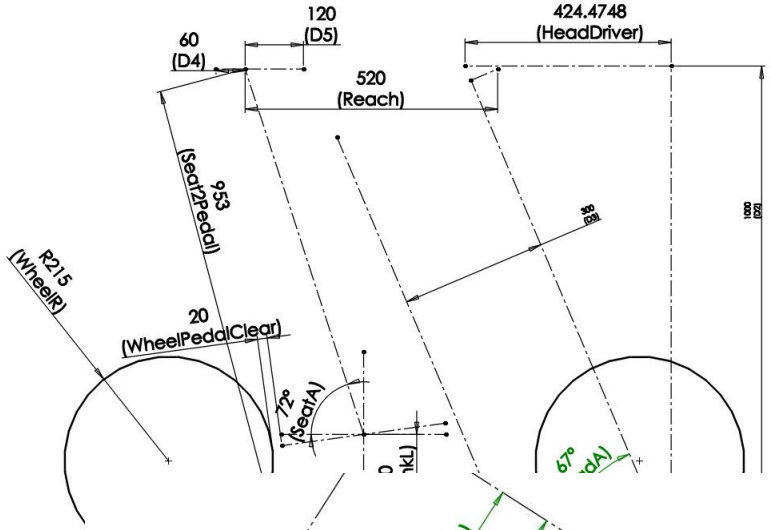
Design Challenges for AI

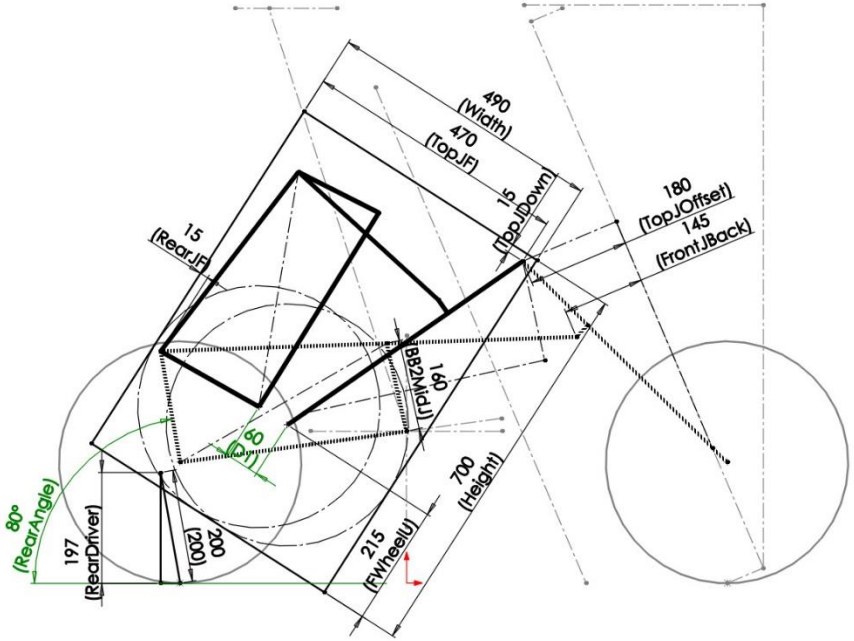
- Mechanism Optimization
- Structural Lightweighting

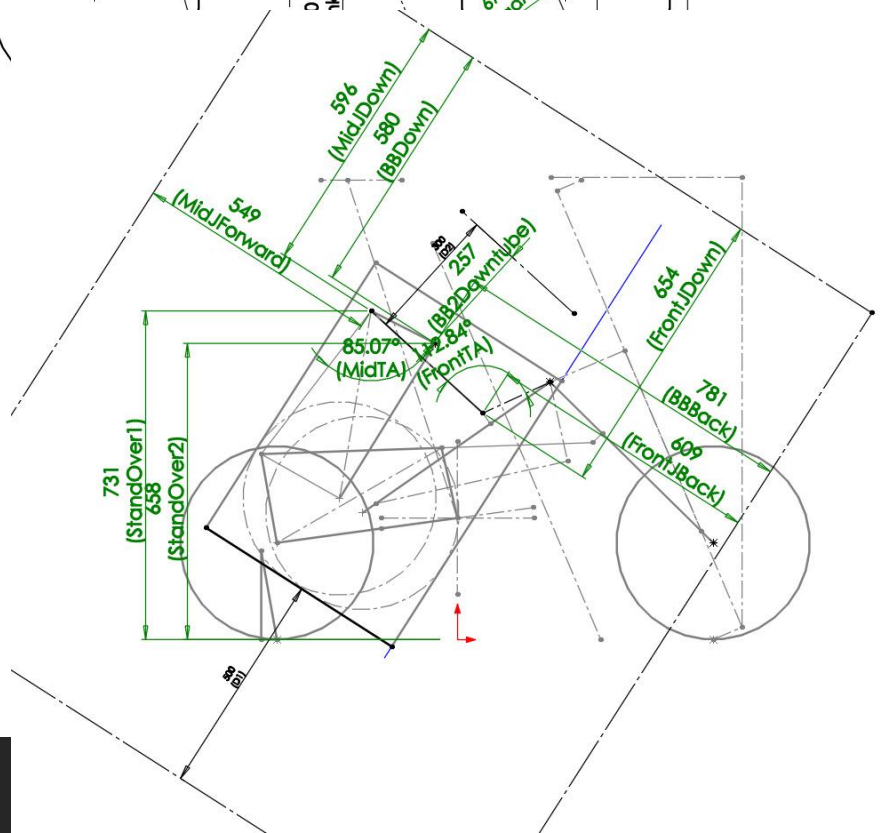
Geometric Constraint Solver

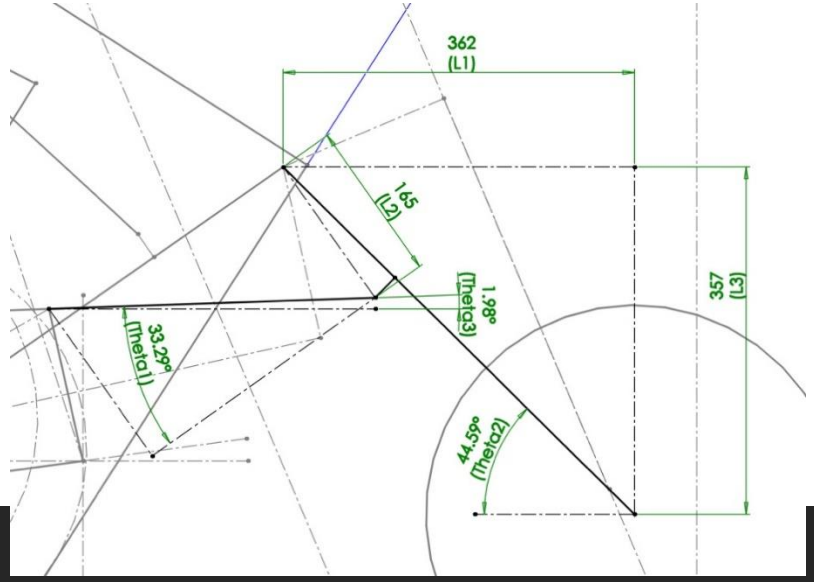


Geometric Constraint Solver

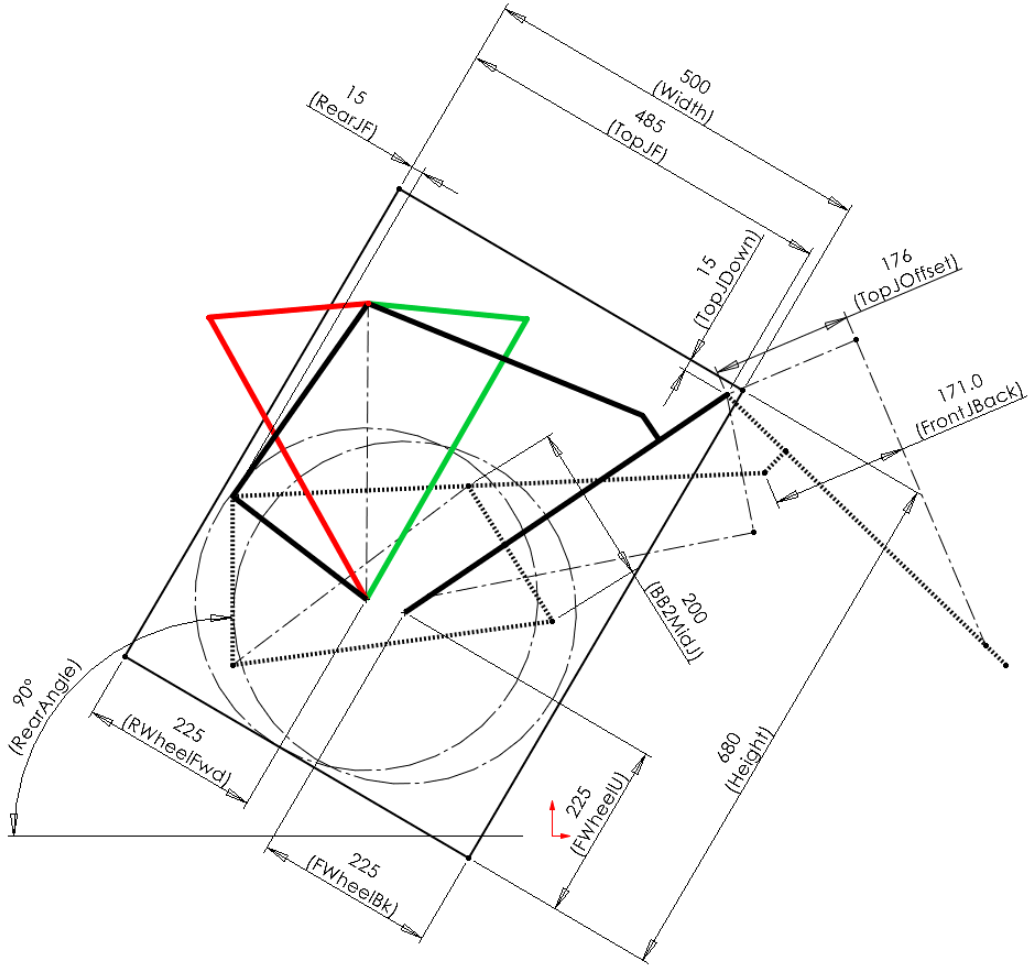


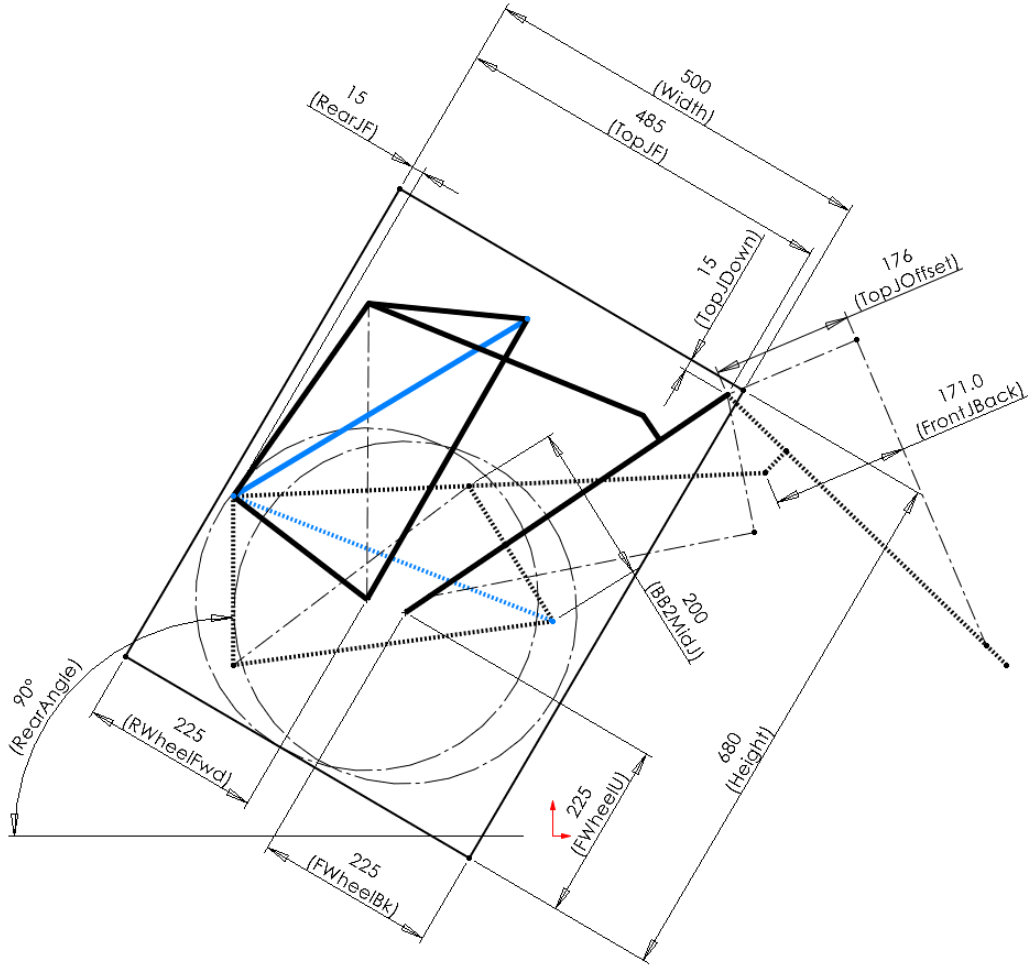




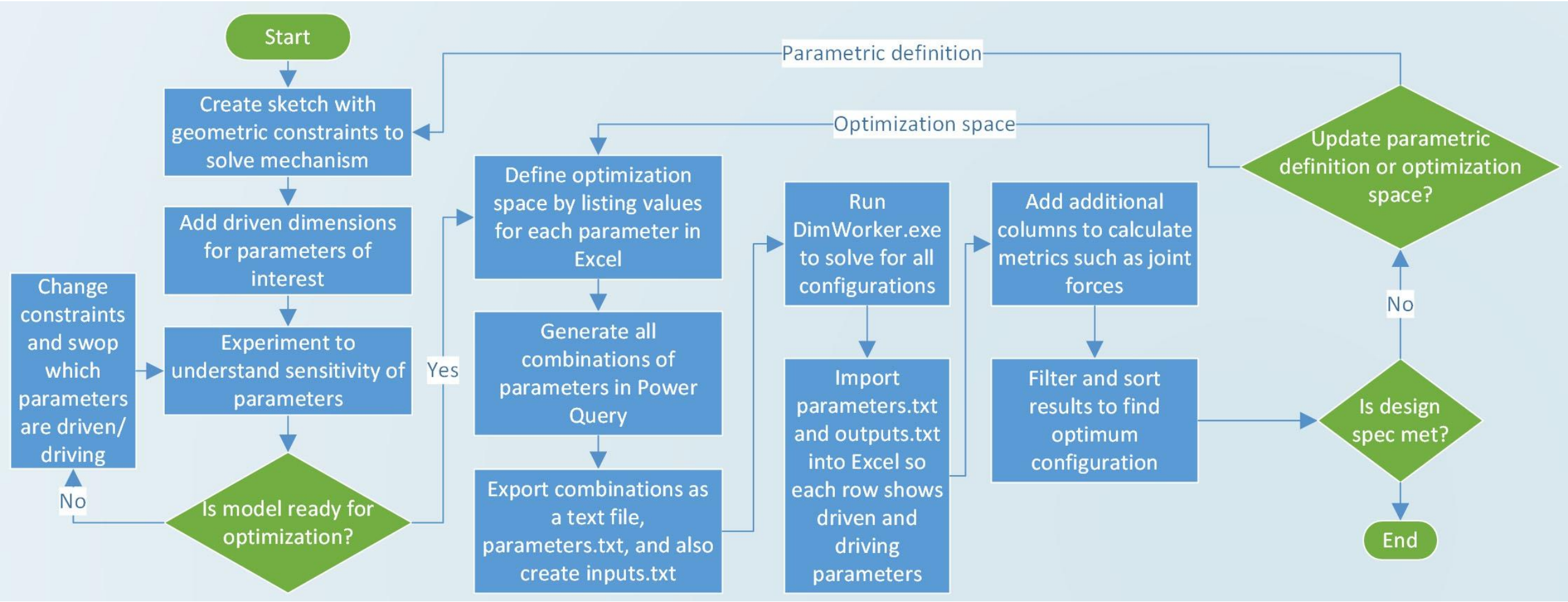


Example Geometric Instability





Mechanism: Exhaustive Search & filter



Mapping First Order Parameter Responses

Angles	Model Parameters	Model Outputs	Calculated Responses	
HeadA, θ_1	$X_1 = 1000 / \tan\theta_1$ → HeadDriver, x_1	StemLp300, y_1	Stem length, $z_1 = y_1 - 300$	-50 to 160, ideally zero
	Trail, x_2	MidJForward, y_2	Mid-J Forward, $z_2 = y_2 - 500$	>40
	Wheelbase, x_3	MidJDown, y_3	Mid Joint Down, $z_3 = y_3 - 500$	>40
	PedalH, x_4	BB2Downtube, y_4	BB-downtube clear, $z_4 = y_4 - 300$	>-50, Maximize
	CrankL, x_5	FrontJBack, y_5	Front-J back, $z_5 = y_5 - 500$	>25
	Reach, x_6	BBDown, y_6	BB Down, $z_6 = y_6 - 500$	>70
RearAngle, θ_2	$X_7 = 200 * \sin\theta_2$ → RearDriver, x_7	BBBack, y_7	Pedals BB Inside, $z_7 = \sqrt{(y_7 - 500)^2 + z_6^2} - x_5$	>25
	Width, x_8	MidTA, y_8	MidJ Tangle, $z_8 = IF(y_8 < 90°, y_8, 180 - y_8)$	>25deg
	Height, x_9	FrontTA, y_9	FJoint Tangle, $z_9 = IF(y_9 < 90°, y_9, 180 - y_9)$	>25deg
	TopJF, x_{10}	StandOver1, y_{10}	<740	
	TopJOffset, x_{11}	StandOver2, y_{11}	<740	
	FrontJBack, x_{12}	L1@FBD, y_{12}		
	FWheelU, x_{13}	L2@FBD, y_{13}		
	BB2MidJ, x_{14}	L3@FBD, y_{14}		
	RearJF, x_{15}	Theta1@FBD, y_{15}		
		Theta2@FBD, y_{16}		
		Theta3@FBD, y_{17}		

$$R_1 = \frac{F_1 y_{12}}{y_{13} \cos y_{15}}$$

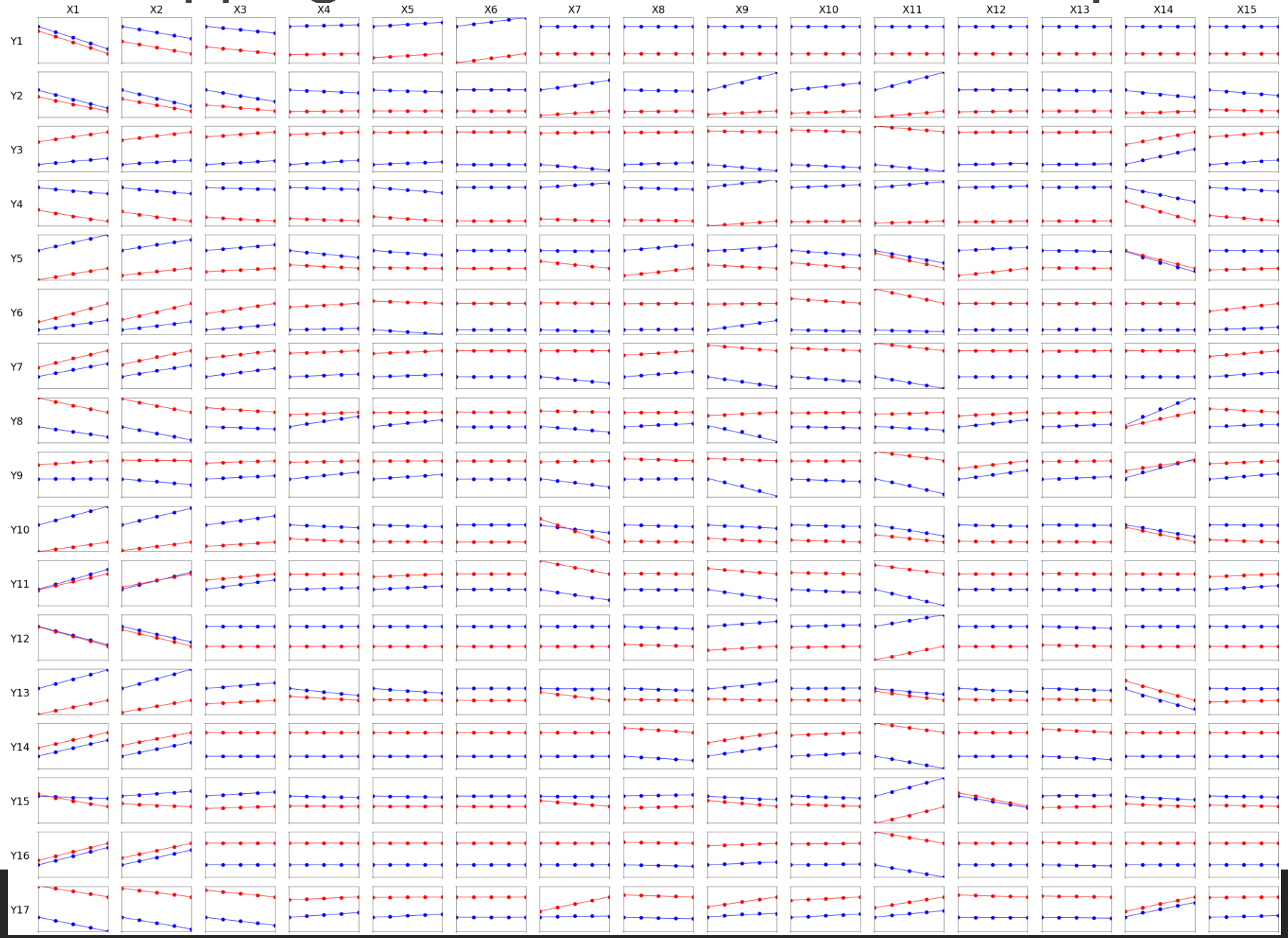
$$R_2 = \sqrt{(R_1 \cos y_{17})^2 + (F_1 - R_1 \sin y_{17})^2}$$

$$R_3 = \frac{F_2 y_{14}}{y_{13} \cos y_{15}}$$

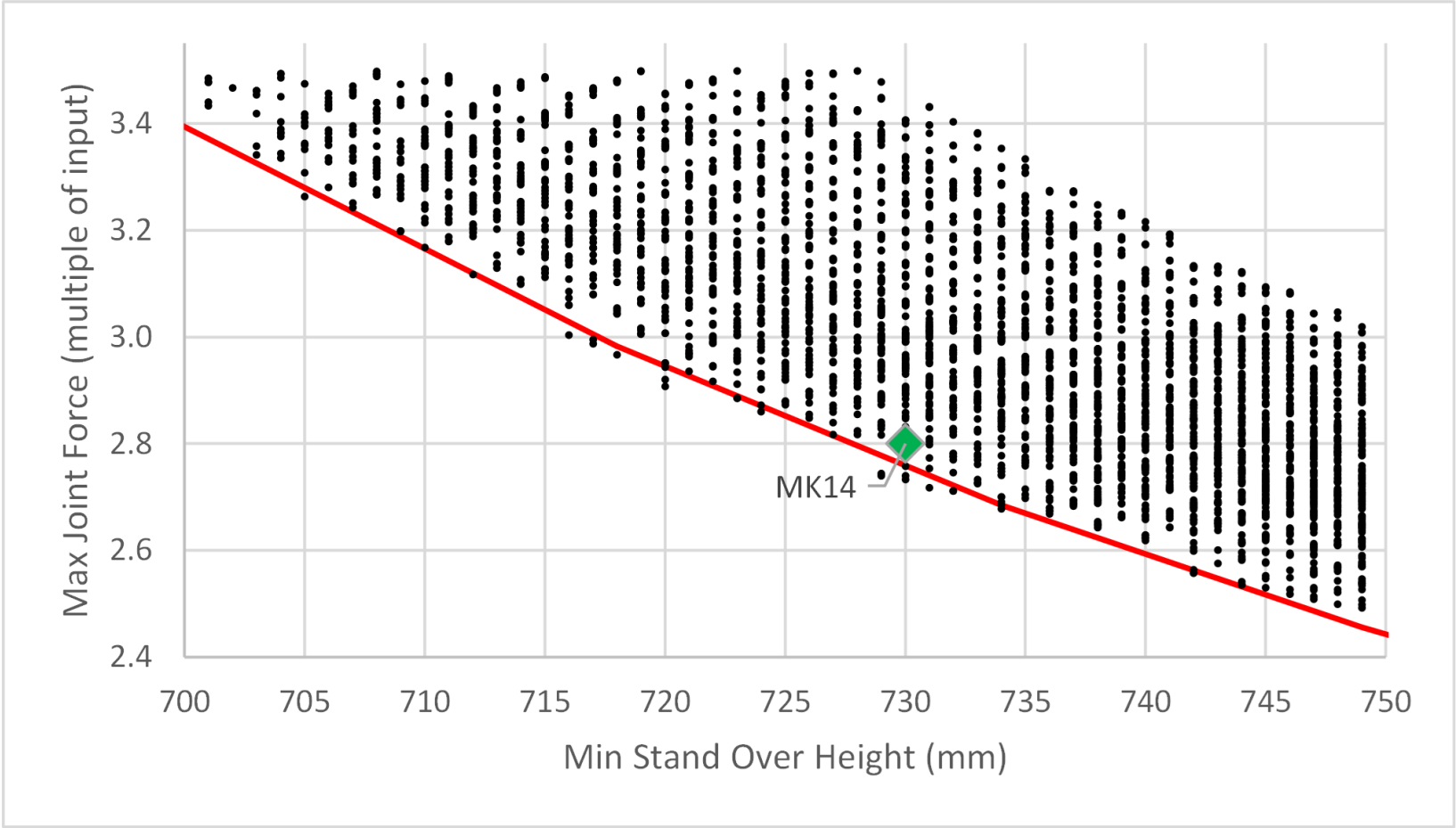
$$R_4 = \sqrt{(R_3 \cos y_{17} - F_2)^2 + (R_3 \sin y_{17})^2}$$

Max joint force, R_{max} — Minimize

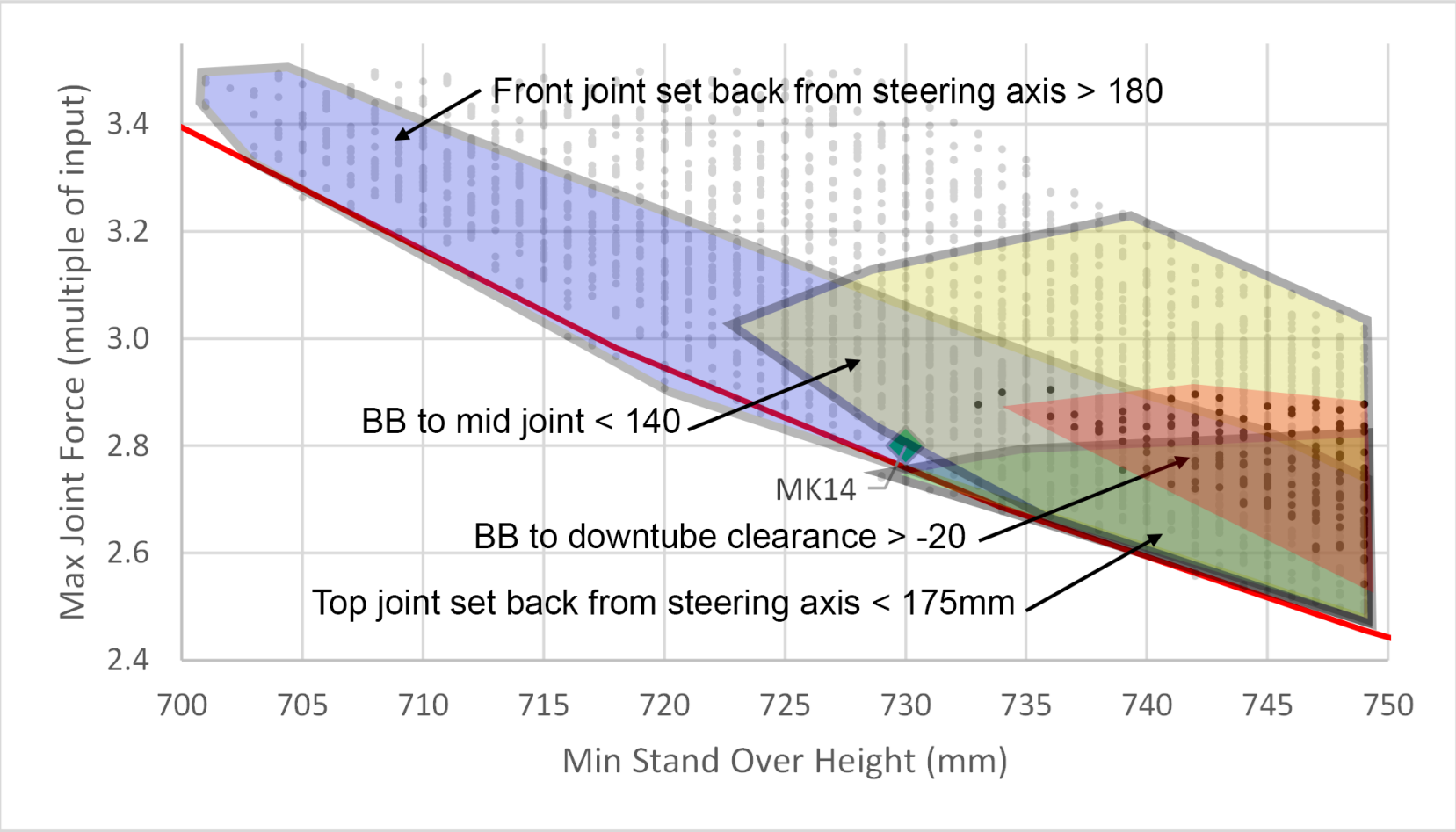
Mapping First Order Parameter Responses



Pareto Optimization



Pareto Optimization



BriefBike: A folding bike that makes cycling more convenient

jody@betterbicycles.org

“BriefBike will get far more people cycling”

RICHARD GRIGSBY, CO-FOUNDER OF THE UK’S LARGEST CYCLE-TO-WORK SCHEME

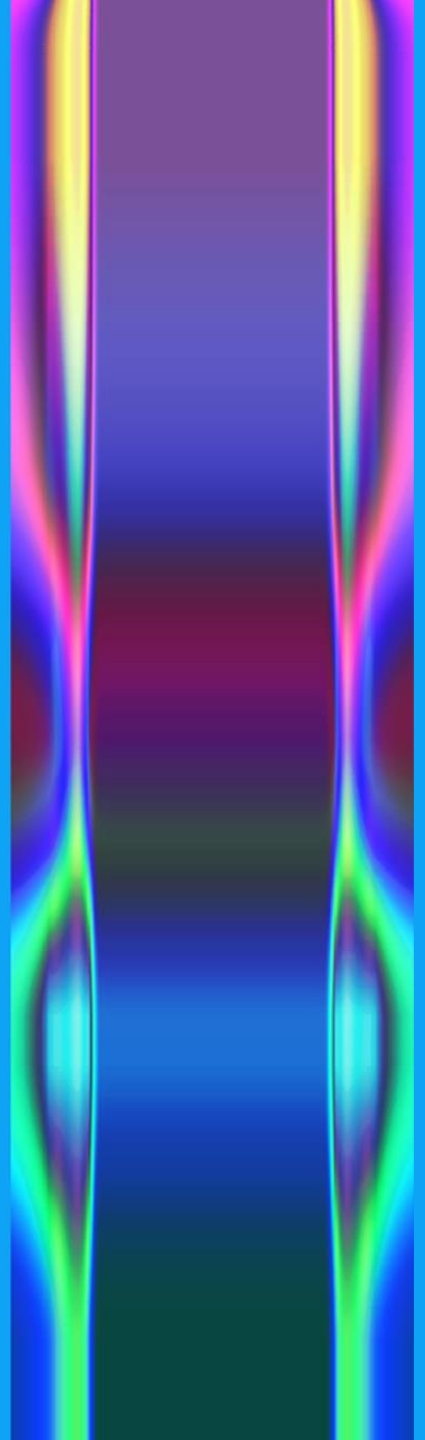
“We’re ready to produce BriefBike at volume, with capacity for five-million units a year”

STEVE GILL, MD OF LUPTON AND PLACE, EUROPE’S BIGGEST DIECASTER

Andrew Gardener

Technical Director

Galebreaker Ltd



UKRI Innovate UK BridgeAI

techSPARK* bristol

Animal Centred Controlled Environment for Dairy

BridgeAI Regional Roadshow

Tues 29th April 2025

Innovate UK Project No: 10123764

Andrew Gardner

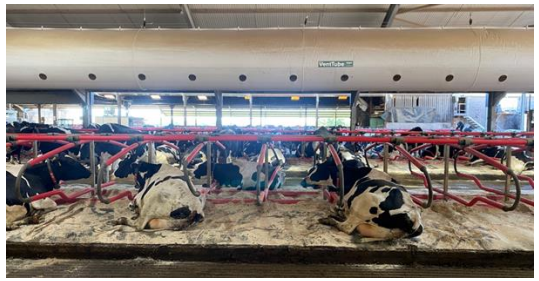
Technical Director, Galebreaker

Galebreaker®

SMARTBELL

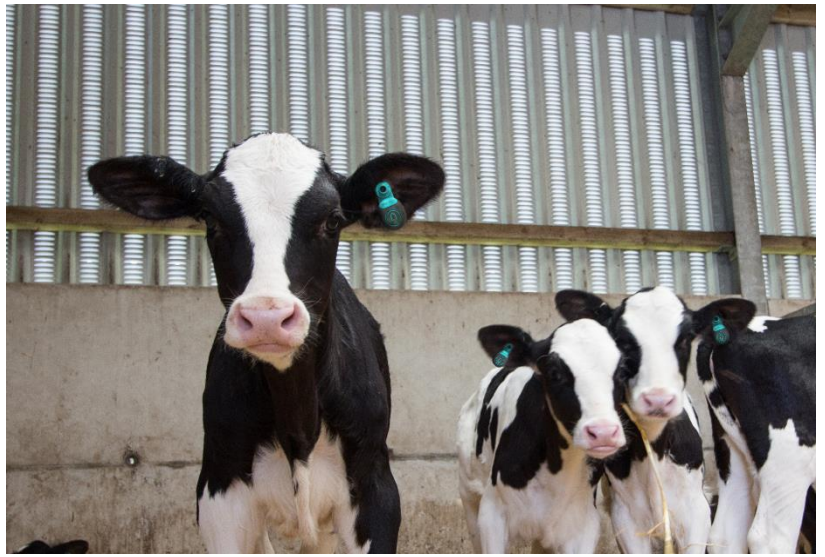
EST. 1984 Galebreaker® AGRI

- Established for 40-years
- Design, Manufacture and Sell Worldwide
- Animal Welfare Solutions – putting animals first with building environment optimisation



Ventilation and Weather Protection

SMARTBELL



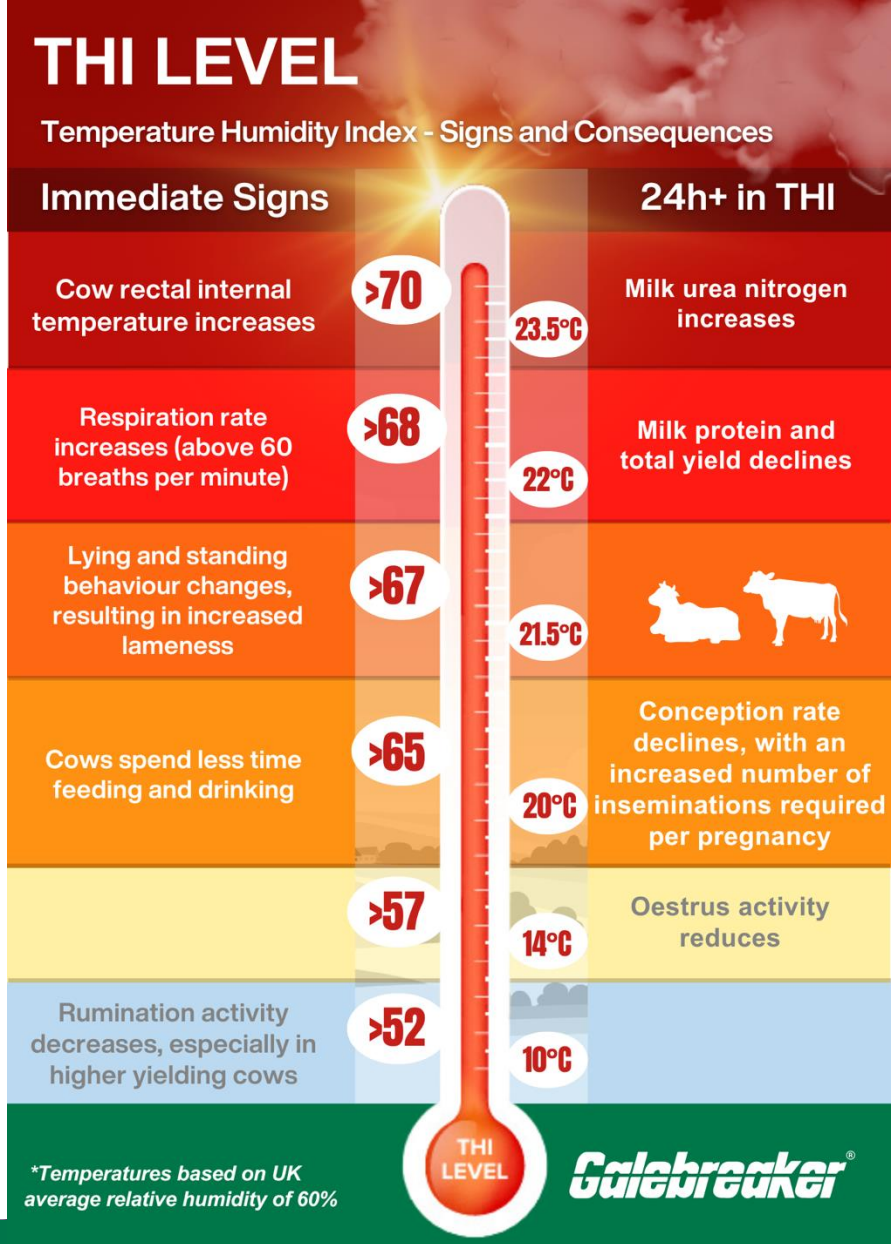
- Established in 2016
- Animal health and environmental monitoring
- Behaviour analysis, health alerts, helping make the best out your investment
- Technology infrastructure and Artificial Intelligence

ACCED – Project Phases

Feasibility to Proof of Concept: Innovate UK

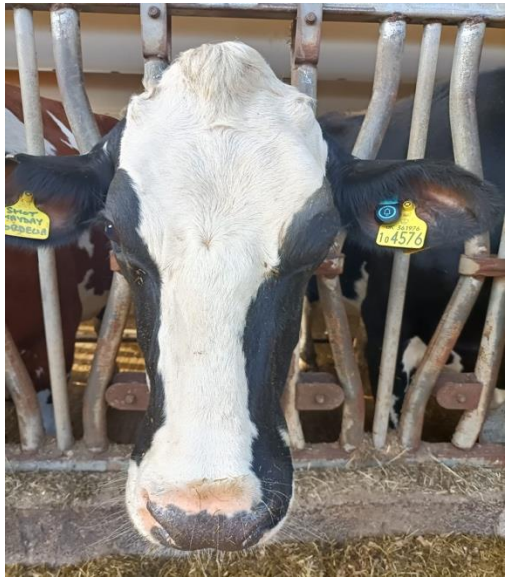
1. Can Artificial Intelligence replace farmer visual and animal husbandry skills to detect early signs of heat stress in cows

2. *How can this be integrated with ventilation control parameters to optimise housed environments*

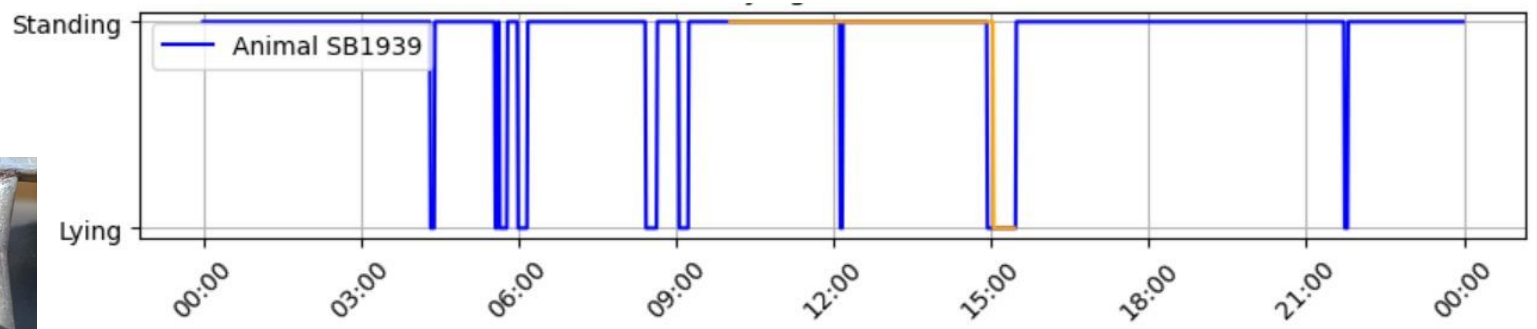


What we did…

1. Ear-Tag

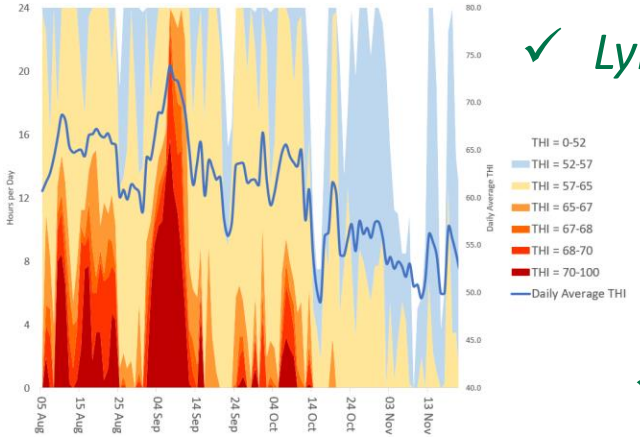


2. Test Farms



Metric	Mean	Median	Max	Min
Sensitivity	0.9166	0.9626	1	0.7027
Specificity	0.8845	0.8674	1	0.7778
Positive Predictive Value	0.8855	0.8781	1	0.8
Negative Predictive Value	0.9262	0.9594	1	0.75
Accuracy	0.8998	0.9121	1	0.7763

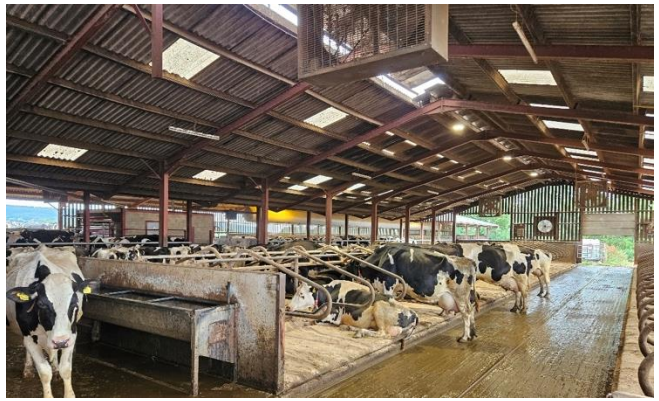
3. Behaviour Modelling



4. Real-Time Behaviour Analysis

✓ *Lying*

✓ *Ruminating*



✓ *Feeding*

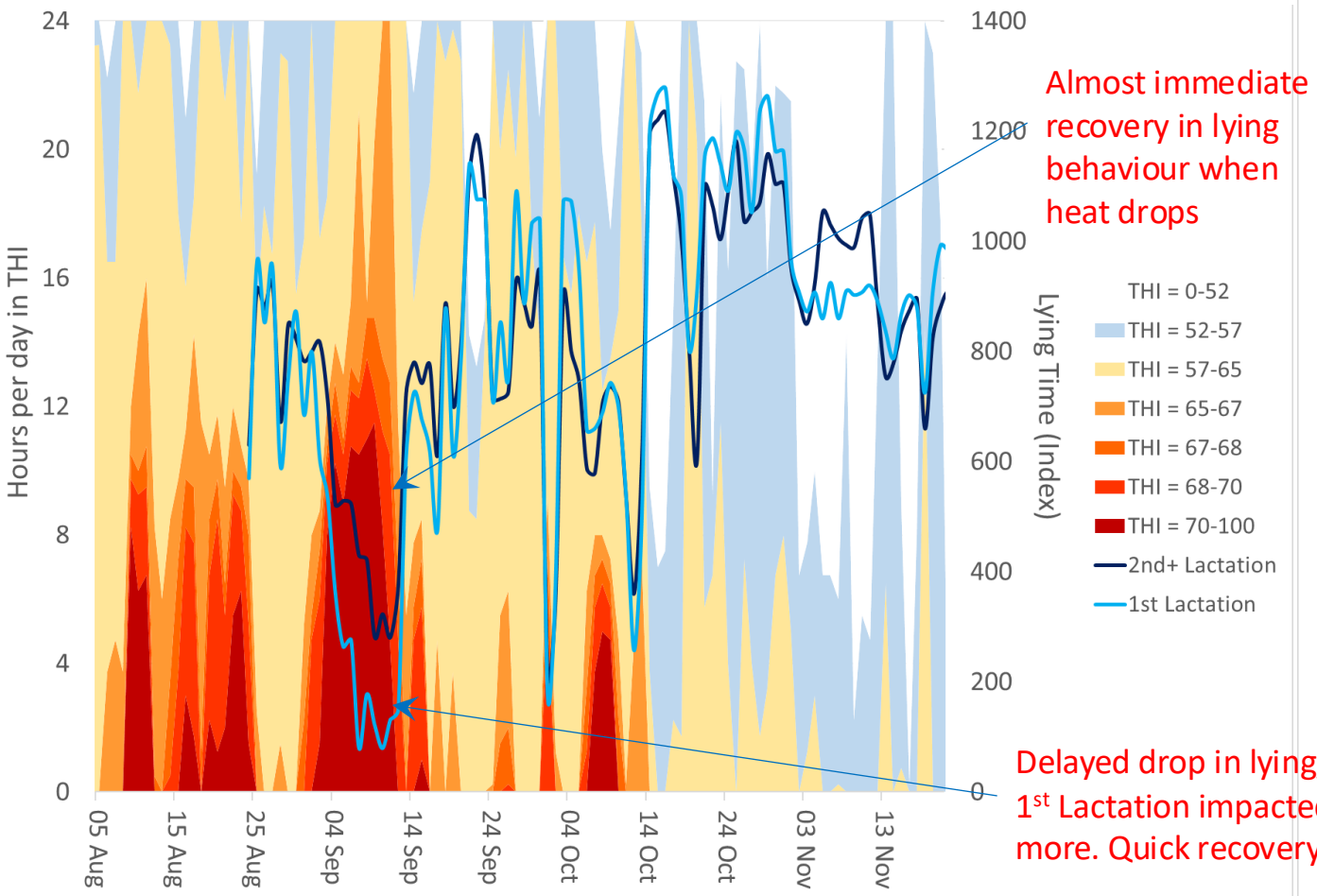
✓ *Standing*

Galebreaker® SMARTBELL

ACCED

Cow Behaviour: Lying

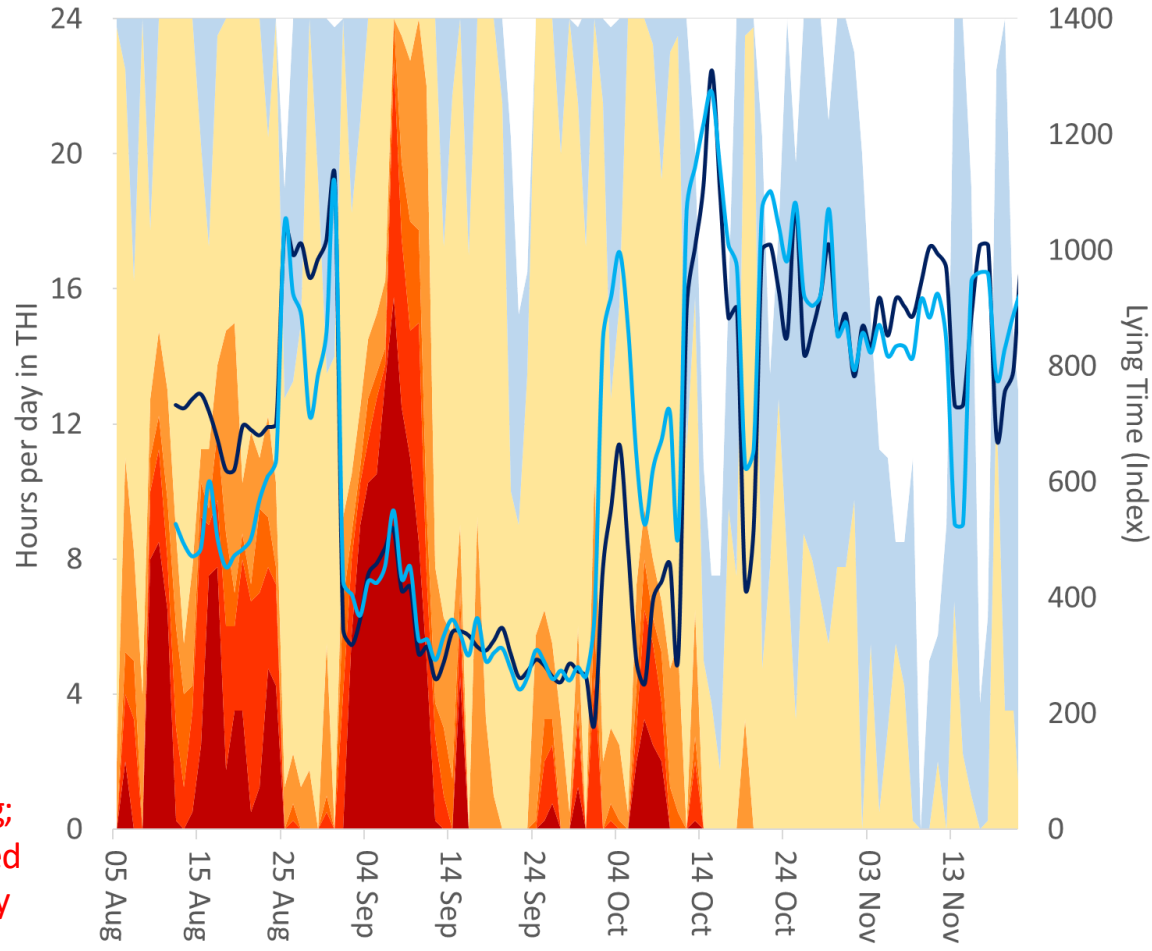
Farm 1 – With Galebreaker VentTube Cooling



Almost immediate recovery in lying behaviour when heat drops

Delayed drop in lying; 1st Lactation impacted more. Quick recovery

Farm 2 – Poor Ventilation



ACCED(2) - Proof of Concept

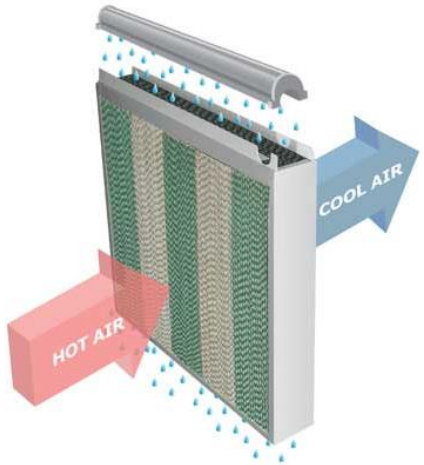
A Cow Centred approach to control of Ventilation

Animal Behaviour + Environmental Conditions = Control system Index

Hybrid Ventilation System and Control

1) Natural Ventilation

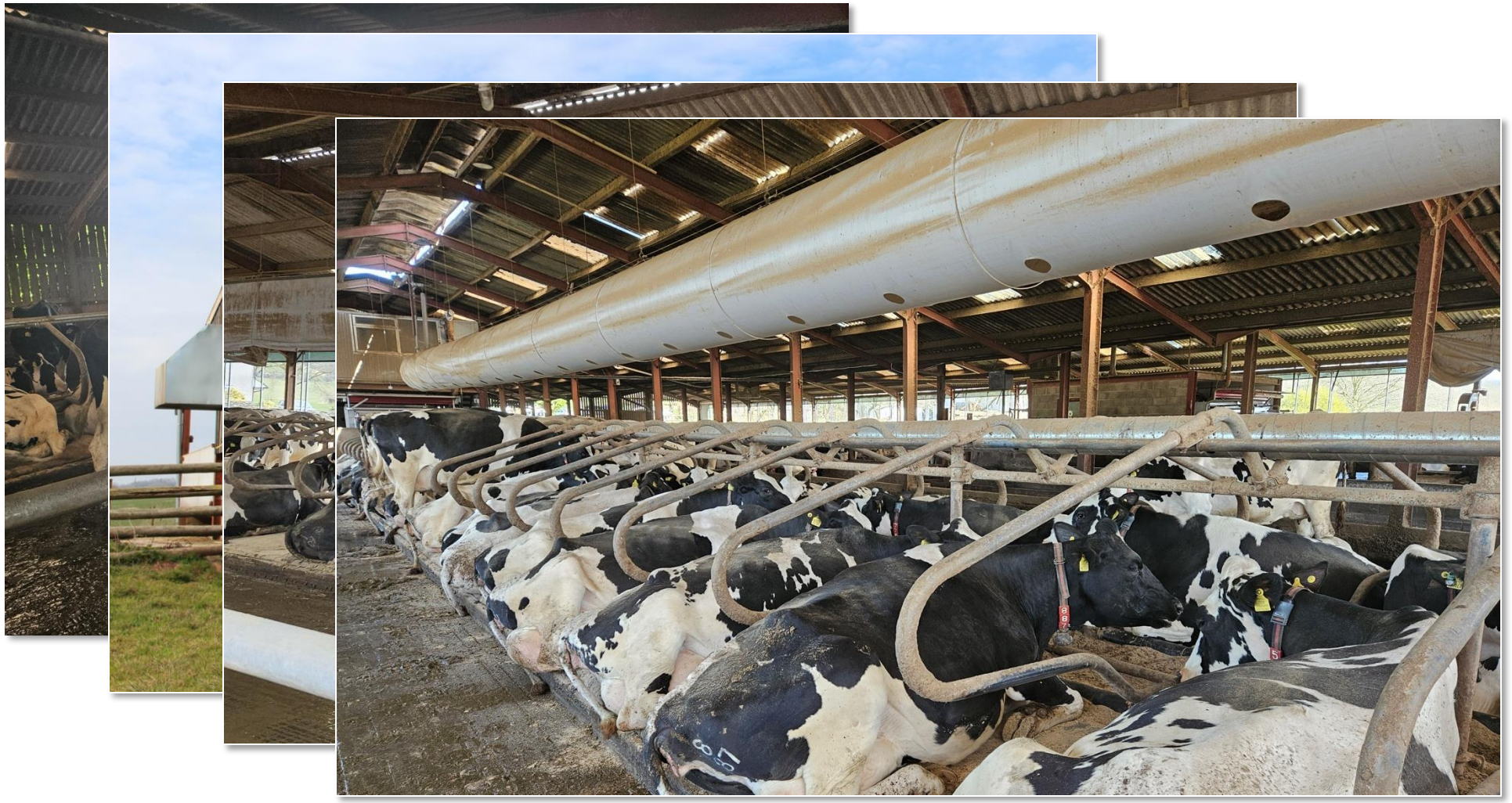
2) Mechanical Convective Cooling

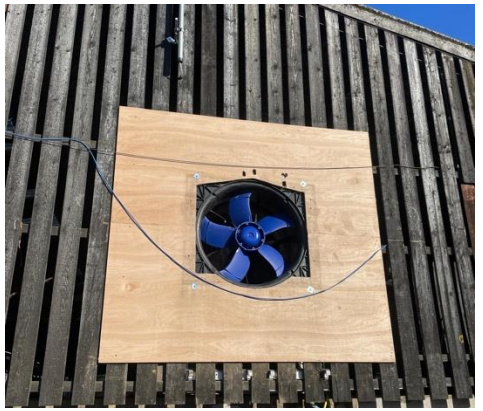


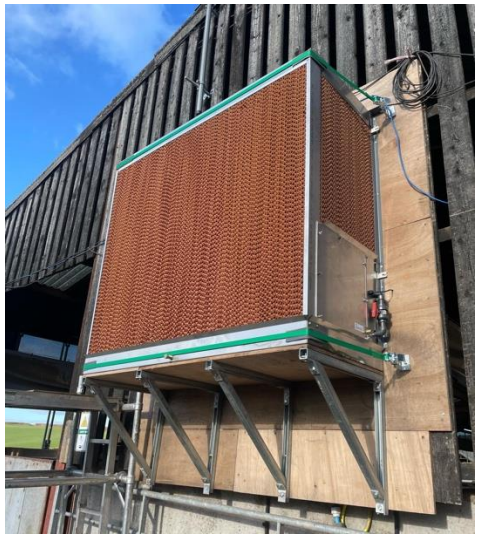
3) Pre-Cooling at Air Inlet

=

Farm Proof Of Concept Implementation







Galebreaker® SMARTBELL

ACCED

Control System

System intelligence and communications

Cloud

App

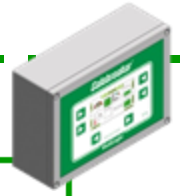
Sensors

Behaviour sensors

Wireless Environmental sensor

Gateways

Natural ventilation and cooling controls



Curtain Controller

Curtains

Wired weather station

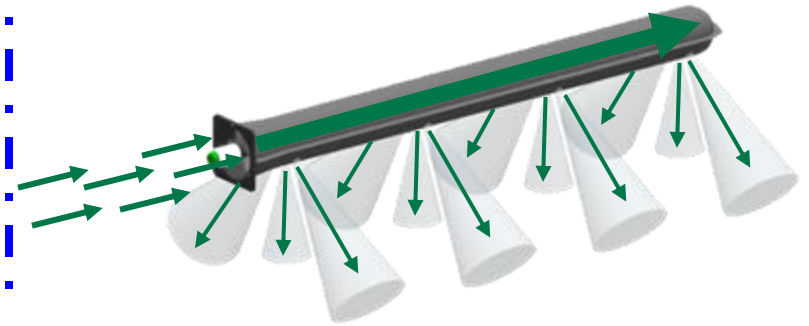
Ventilation controller

Forced ventilation and cooling controls

Tube deployment

Fan actuator

Cooling controller



Summer 2025 Trial

Phase 1: Cow preference of devices & configurations (May-June)

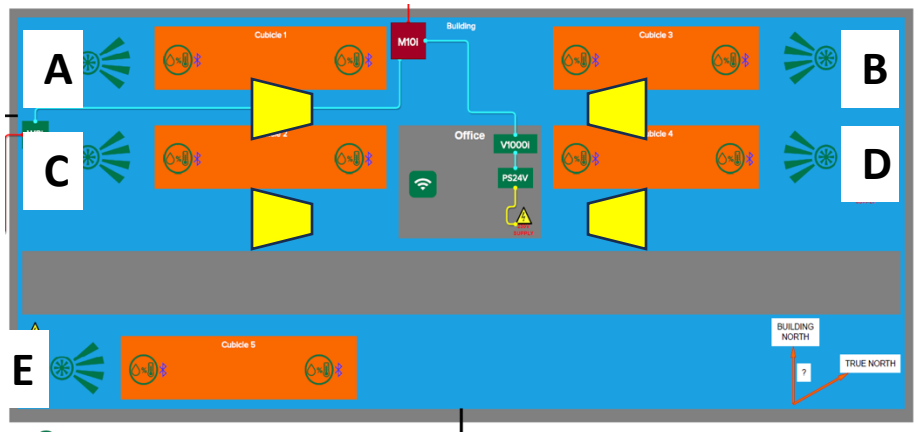
Phase 2: Automatic control of devices (July-Sept)

Phase 3: Analysis of Cow Performance (comparison to previous years – 2023, 2024)

Summer 2025 Trial – AI Visual Monitoring

Vet Vision AI

Features	Cow Comfort Pro
Cow Comfort Index[1]	✓
Cubicle Usage Index[2]	✓
Group lying times	✓
Group standing times	✓
Group feeding times	✓
Activity budget	✓
Heat maps	✓
Zone creation	✓
Link cameras	✓
Benchmarking	✓



Galebreaker® SMARTBELL

ACCED

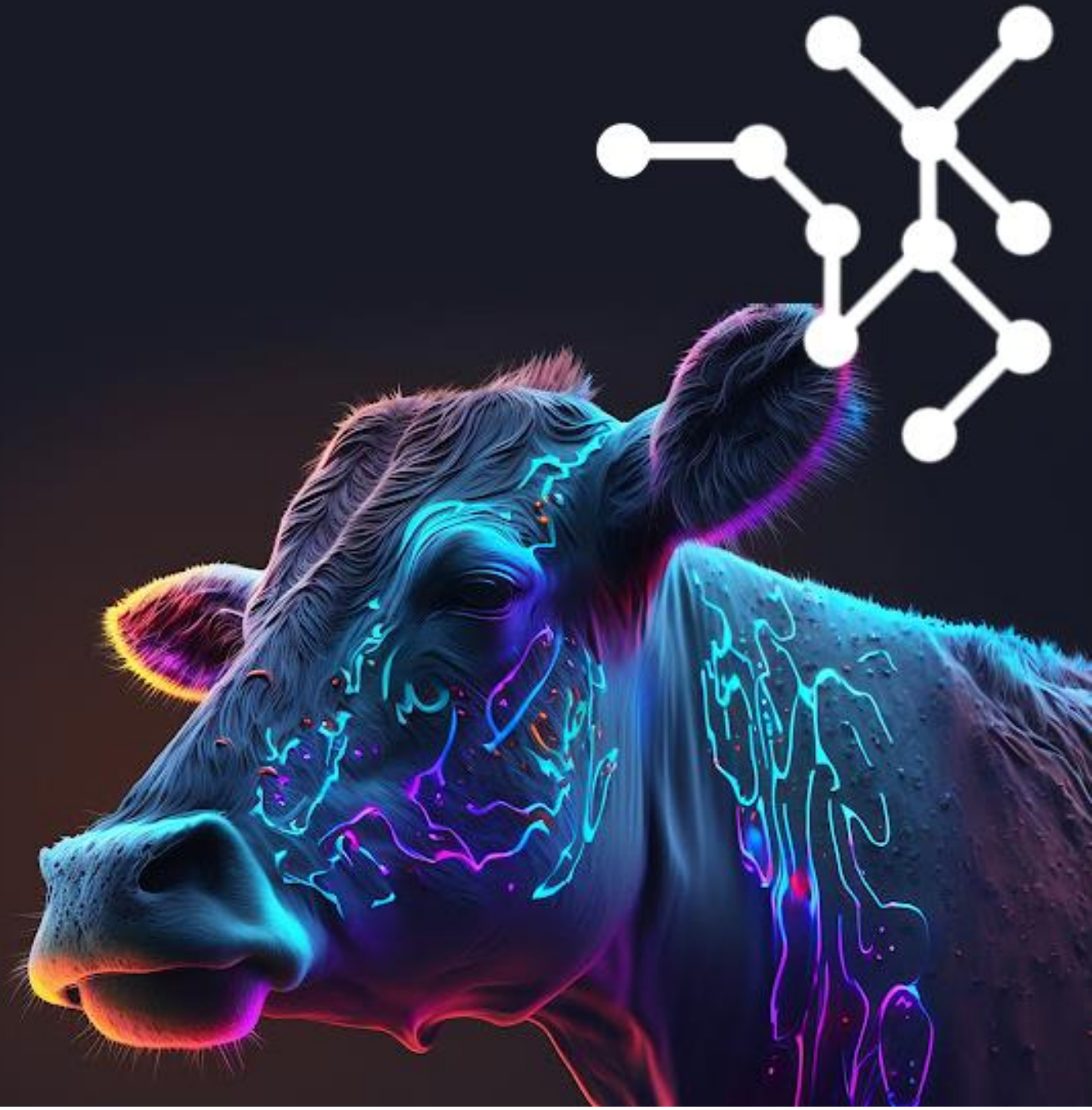
Thank You...

Andrew Gardner

Technical Director, Galebreaker

agardner@galebreaker.com

www.galebreaker.com



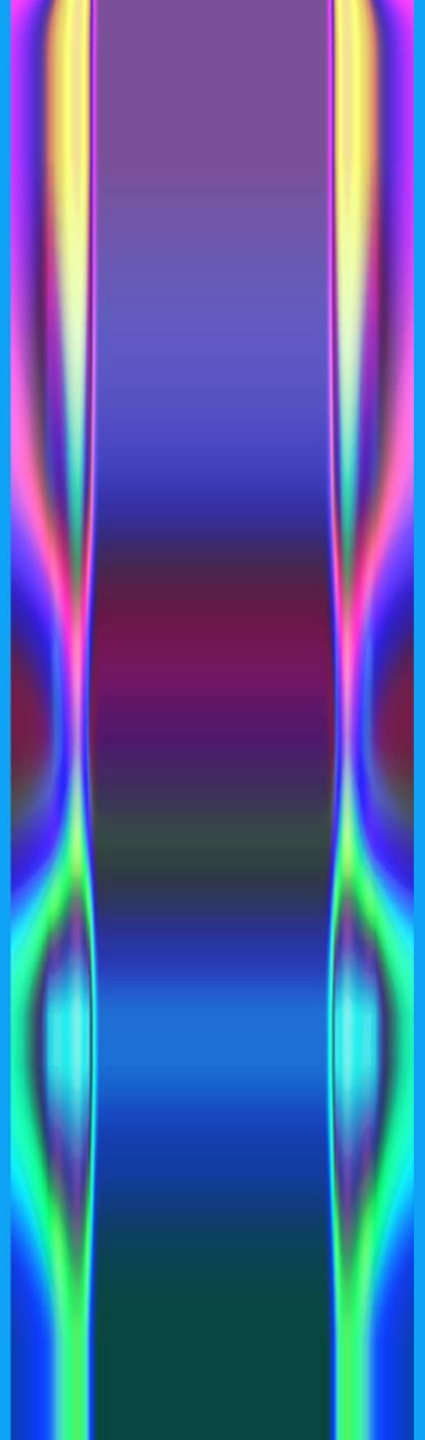
Galebreaker®

SMARTBELL

David Rogers

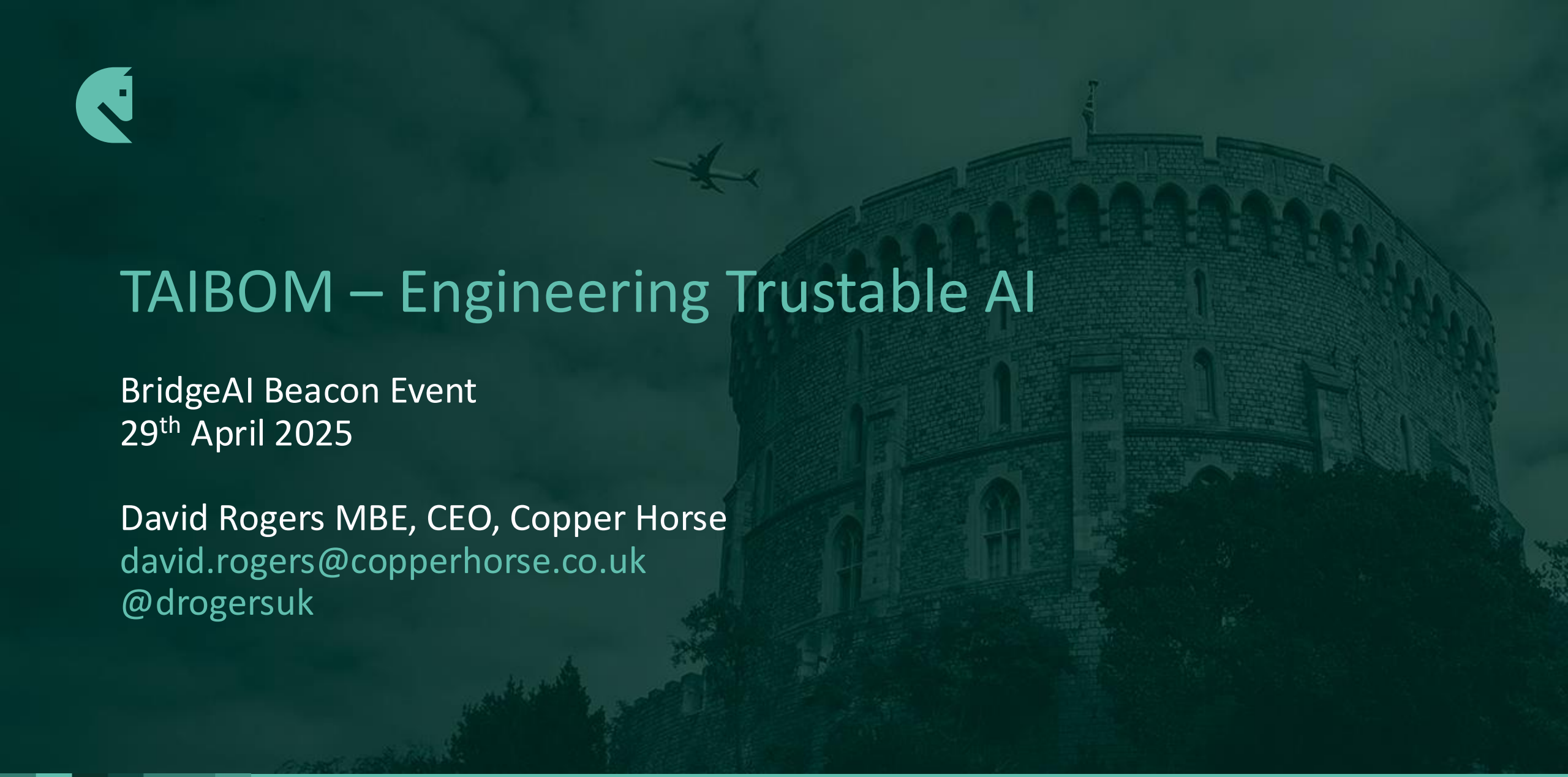
CEO

Copper Horse Ltd



UKRI Innovate UK BridgeAI

techSPARK* bristol



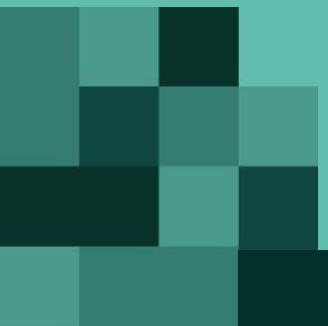
TAIBOM – Engineering Trustable AI

BridgeAI Beacon Event
29th April 2025

David Rogers MBE, CEO, Copper Horse
david.rogers@copperhorse.co.uk
@drogersuk

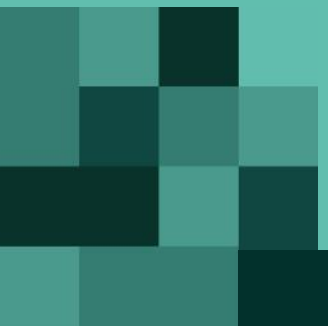
TAIBOM (defn)

Description of an AI system, and its dependencies at a level sufficient to meaningly infer risk



TAIBOM (defn)

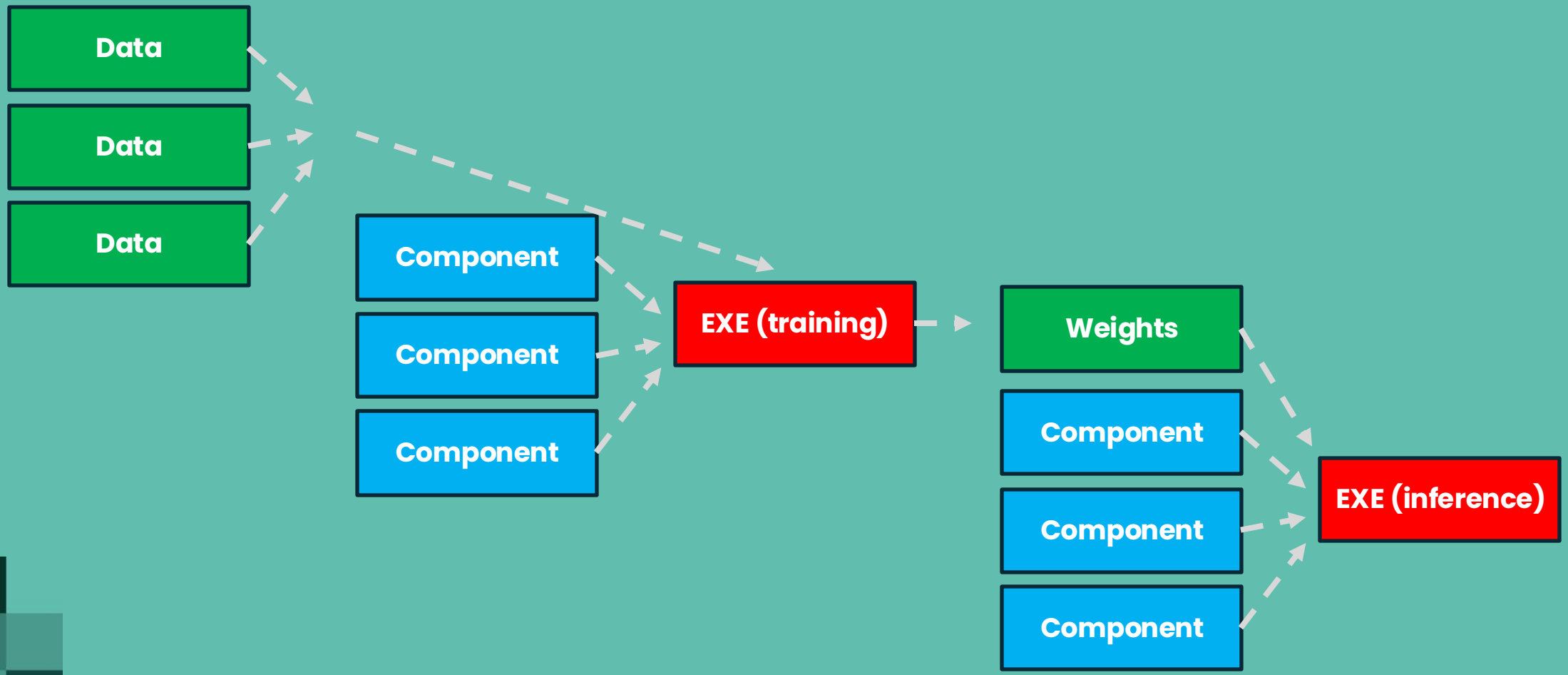
A digitally signed knowledge graph, with descriptors form multiple authors, to describe the relationships an annotations on an AI system



Risk Management

Risk type	Use case
Security	Vulnerabilities (CVE), Data Vulnerabilities (AI CVE) -- Best practice, penetration test +++
Export risk	Foreign Ownership, Control, or Influence (FOCI)
Licensing risk	GPL Pollution, Software commercial
Support risk	Support costs (CSA)
Subrogation	Insurance liabilities

AI Dependencies



The Urgent Need to Standardise and Act

MINJA sneak attack poisons AI models for other chatbot users

Nothing like an OpenAI-powered agent leaking data or getting confused over what someone else whispered to it

APRIL 24, 2025

The GIST

Editors' notes

'Poisoned' AI models can unleash real-world chaos; study shows how these attacks could be prevented

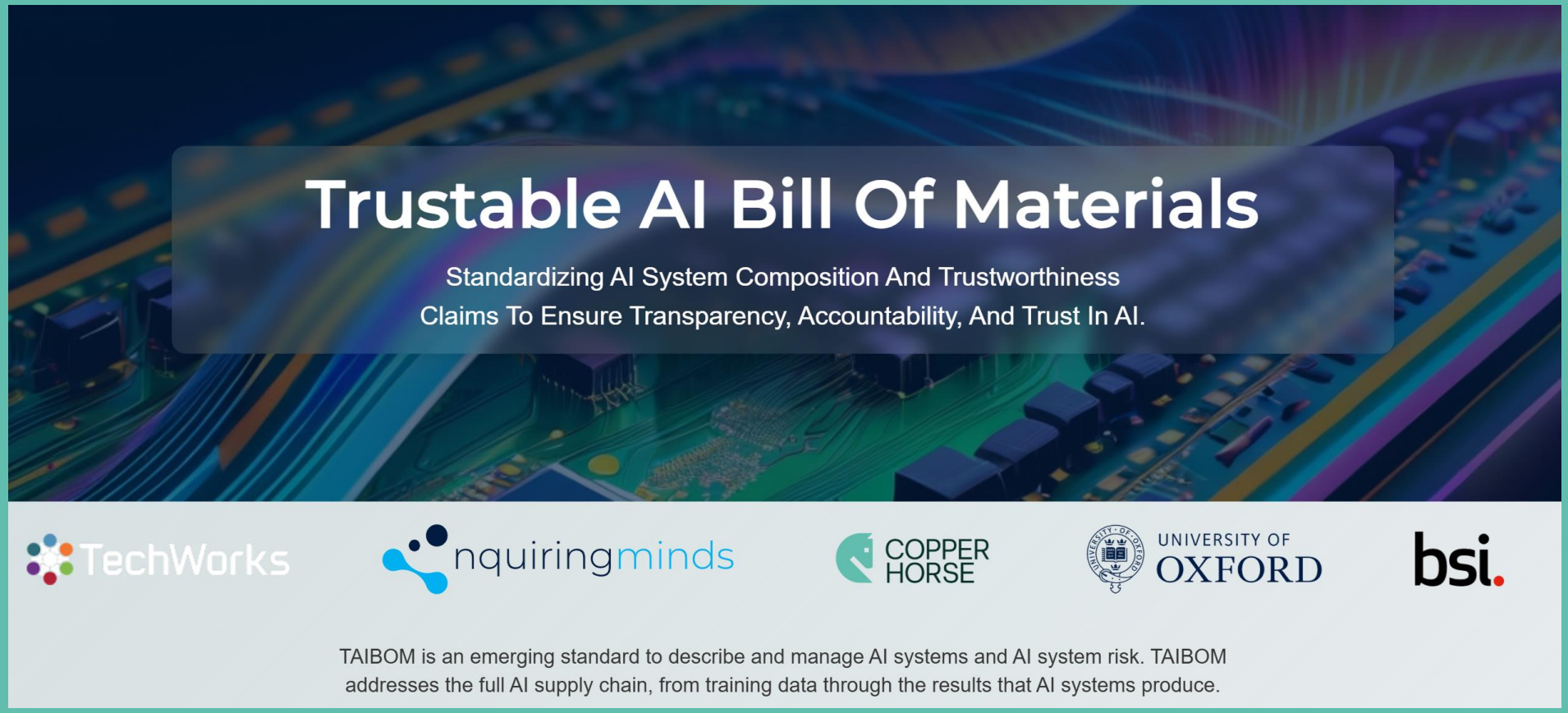
by Angela Nicoletti, Florida International University

ARTIFICIAL INTELLIGENCE

All Major Gen-AI Models Vulnerable to 'Policy Puppetry' Prompt Injection Attack

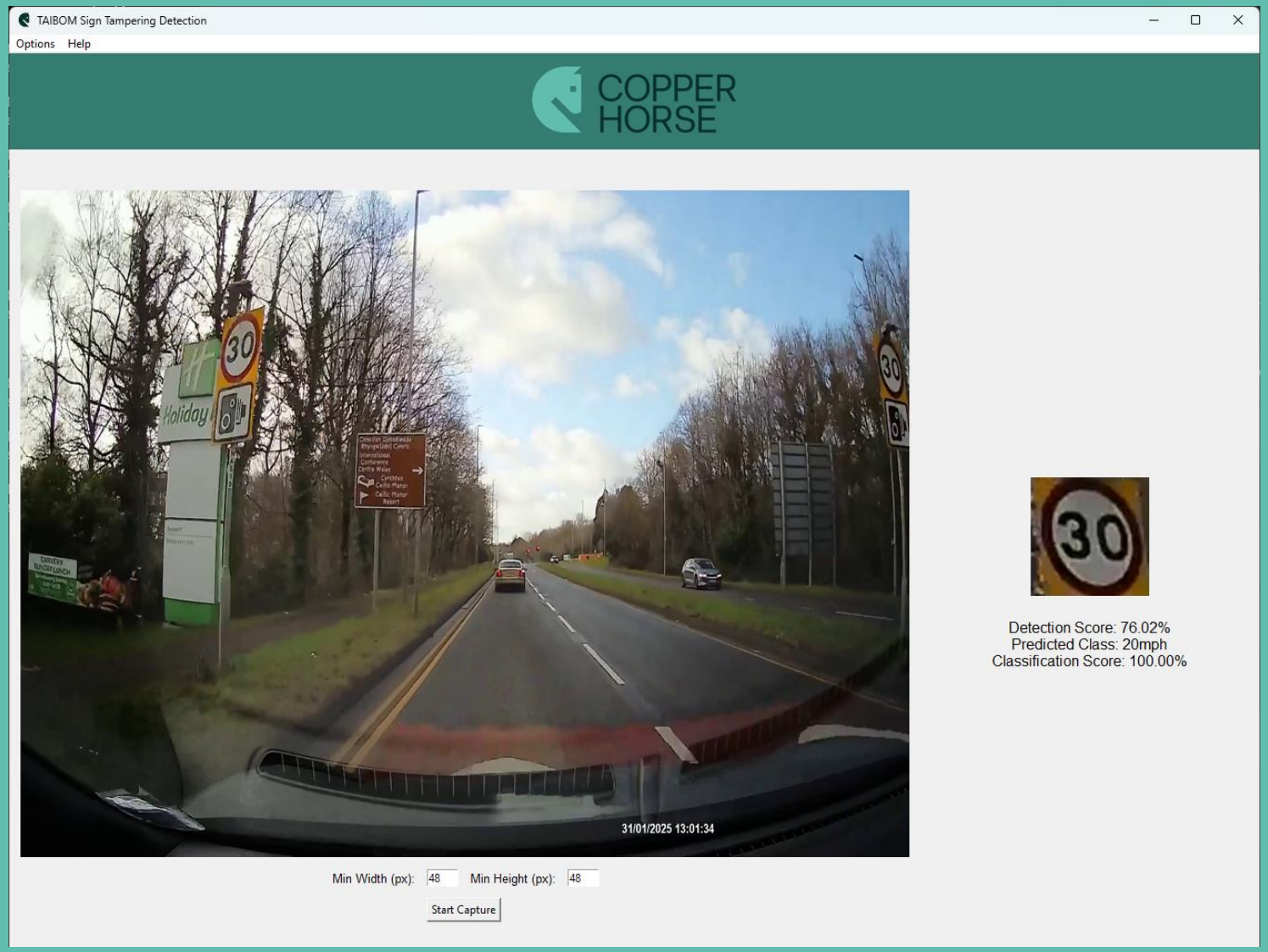
A new attack technique named Policy Puppetry can break the protections of major gen-AI models to produce harmful outputs.

taibom.org

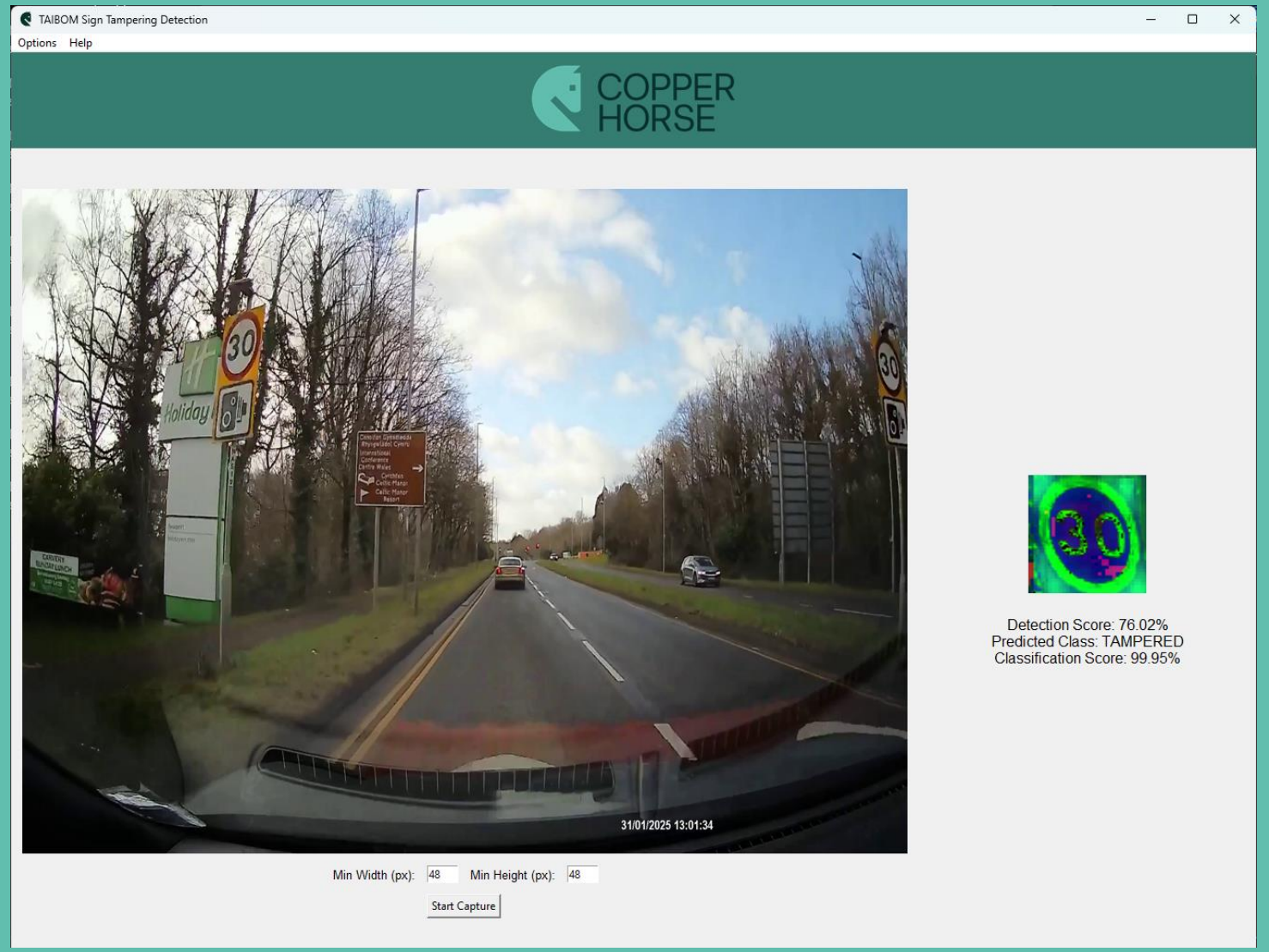

Trustable AI Bill Of Materials
Standardizing AI System Composition And Trustworthiness
Claims To Ensure Transparency, Accountability, And Trust In AI.
TechWorks
nquiringminds
COPPER HORSE
UNIVERSITY OF OXFORD
bsi.
TAIBOM is an emerging standard to describe and manage AI systems and AI system risk. TAIBOM addresses the full AI supply chain, from training data through the results that AI systems produce.

TAIBOM Automotive Test Models and Applications

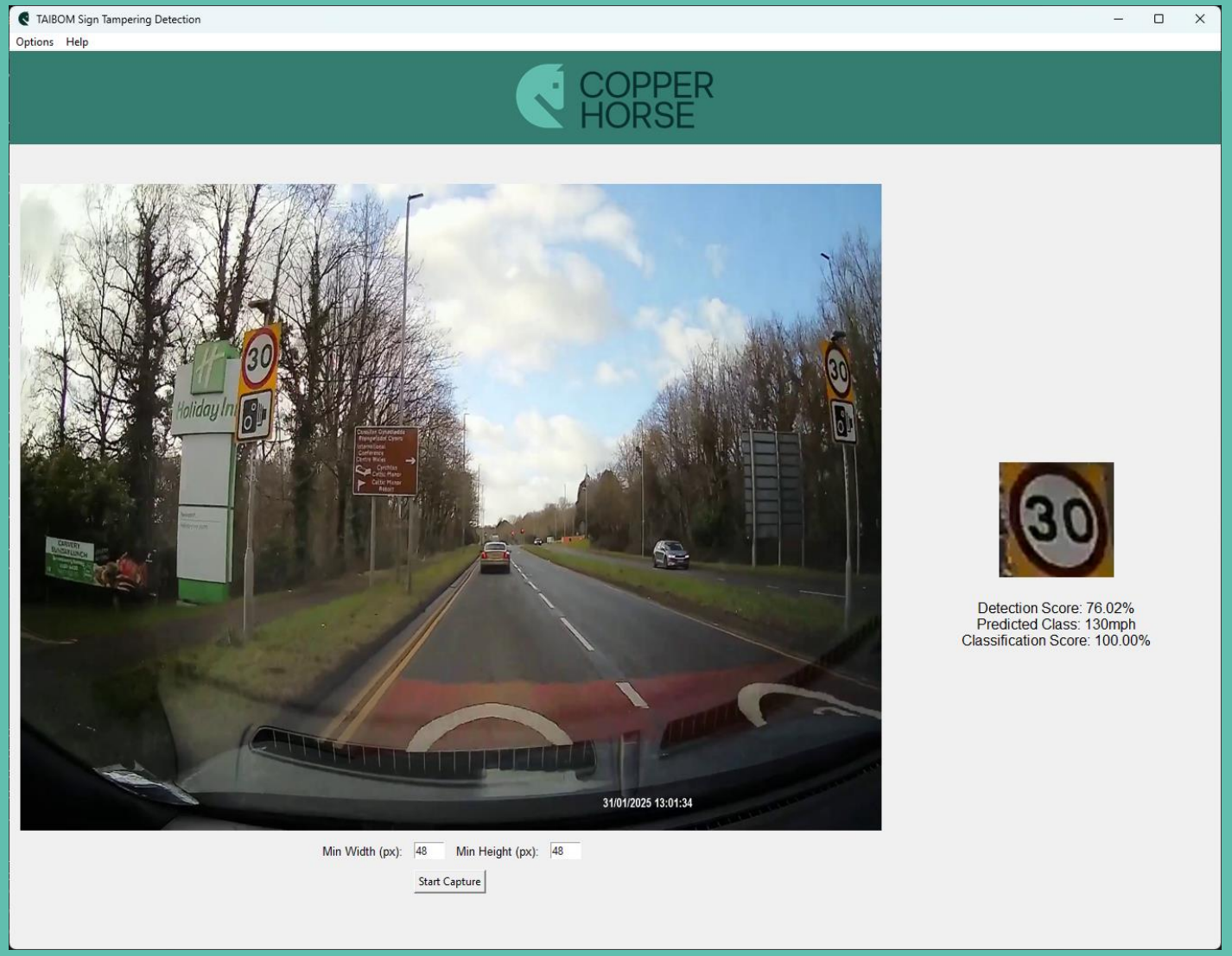
Adversarial Attacks: Model Weights Bias



Adversarial Attacks: Output Labels Modification



Adversarial Attacks: Inferencing



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