



Two-Session-Clustering Workshop

17.02.2021 | SESSION 1:

A virtual user-centric approach to design radically new cabin designs and assess them in terms of optimal energy efficiency use

Presenter:

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HONDA



A virtual user-centric approach

OBJECTIVES

- Clarifying requirements and baseline
- Creating multi-physical simulation model of both the basic and the enhanced vehicle
- Investigation of user-comfort aspects and energy efficiency
- Development of intuitive, user-centric and user-friendly HMI

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APPROACH

- Definition of real-world baseline
- Transfer to virtual world
- Utilisation of virtual tools
- Novel user-centric HMI
- Outlook

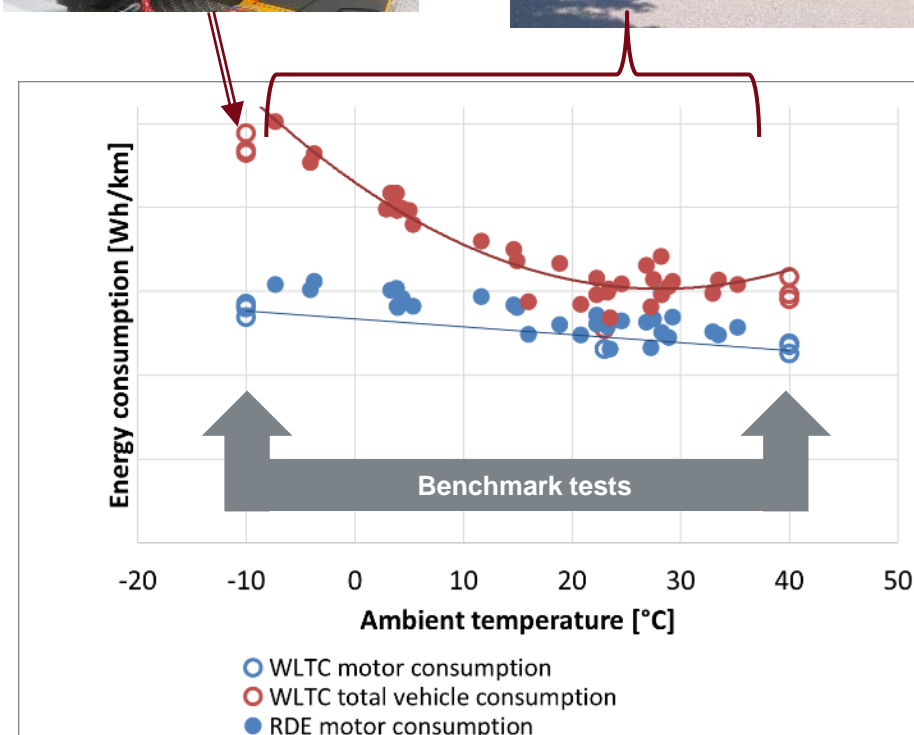
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DEFINITION OF REAL-WORLD BASELINE

- Baseline data measurement on road and laboratory (dyno)
 - Driving modes
 - Real Driving Emission (RDE)
 - WLTC



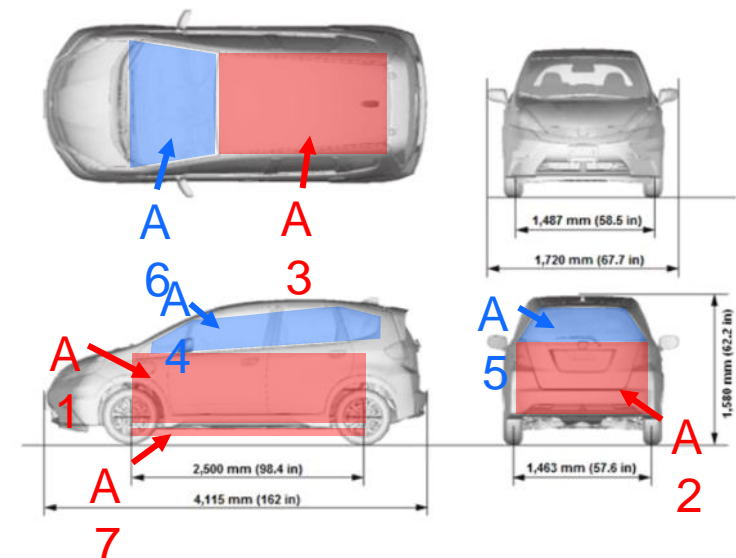
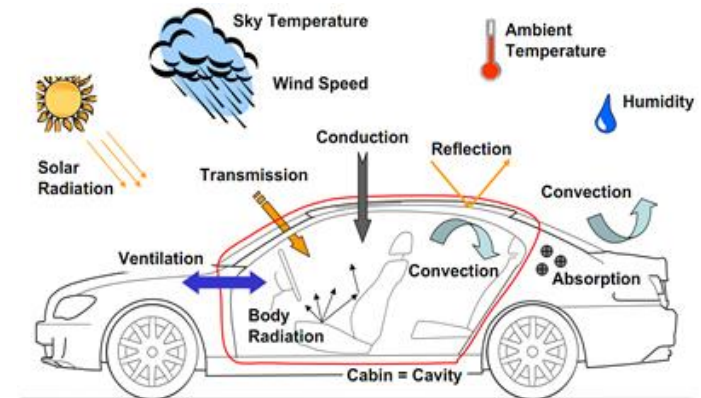
- ➔ WLTC testing defined as final evaluation criterion
- ➔ WLTC testing mode is correctly representing customer usage



A virtual user-centric approach TRANSFER TO VIRTUAL WORLD

- Creation of simulation model
 - Considering influence of ambient conditions
 - Outer vehicle surface separated into different areas
 - Powertrain model and HVAC model of baseline was created

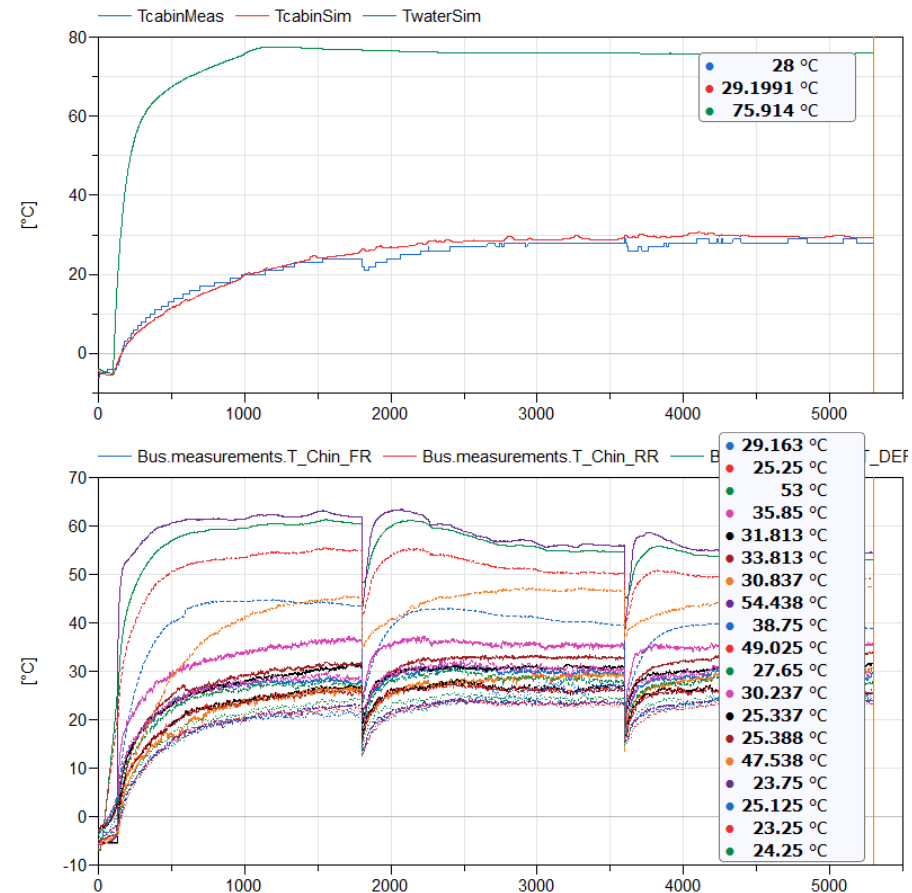
➔ Demonstrator base successfully transferred into virtual world



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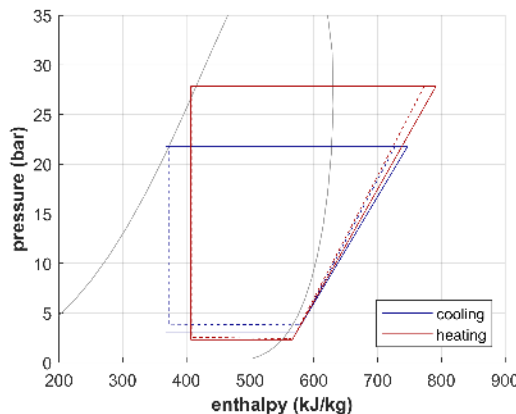
TRANSFER TO VIRTUAL WORLD

- Model of base vehicle
validated using real test data from
WLTC dyno tests
- ➔ Virtual representation of baseline
successfully validated
- ➔ Can be used for further steps

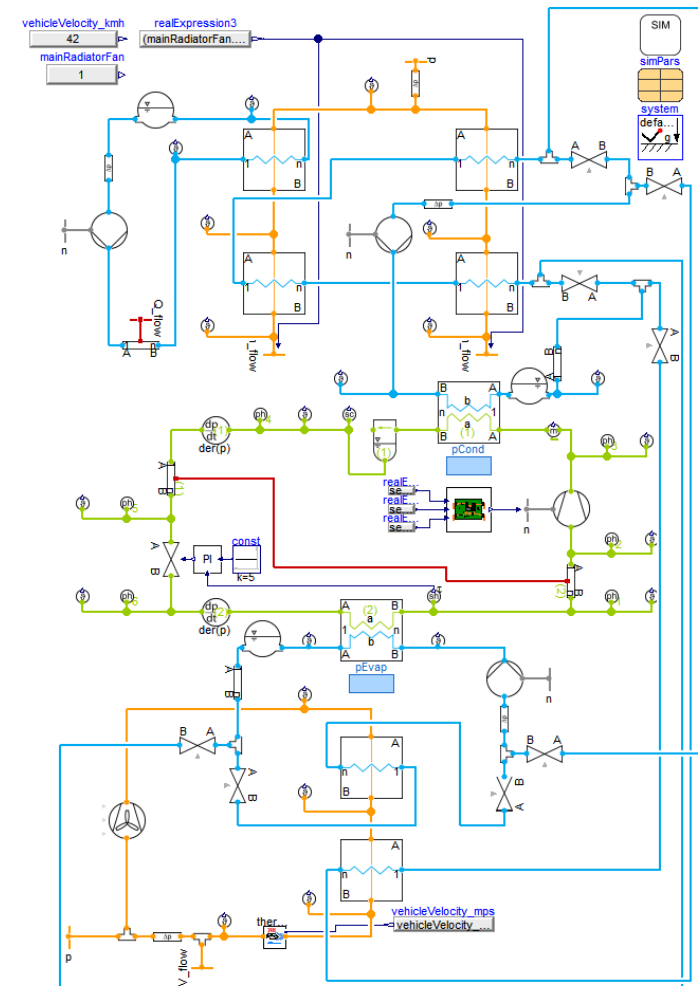


A virtual user-centric approach TRANSFER TO VIRTUAL WORLD

- Model of new HVAC system
- Components parametrised separately
 - Based on specification and test data
- Validated by using p-h diagram from component tests



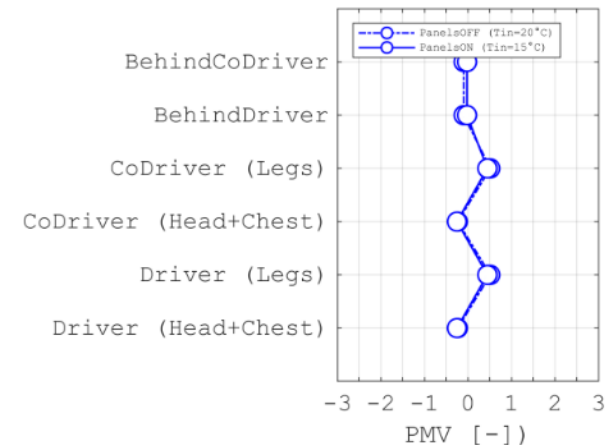
➔ New system successfully validated
with bench test data



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UTILISATION OF VIRTUAL TOOLS

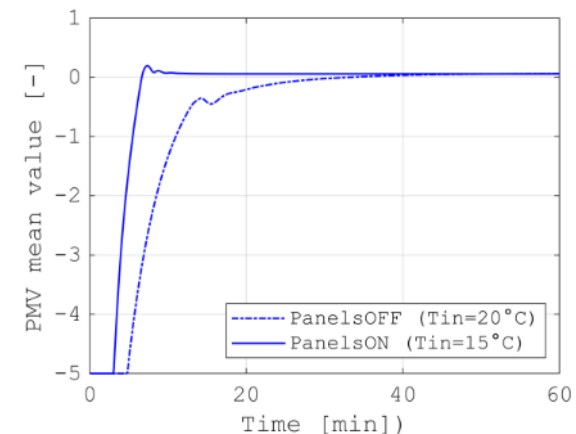
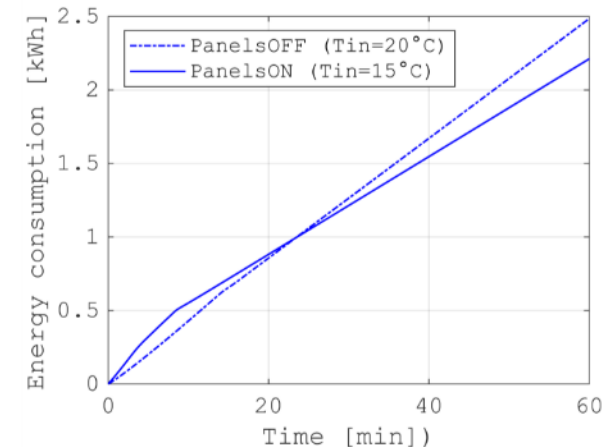
- Development of IR heating elements
 - Direct and efficient heating of occupant
 - Panel location based on partner experience
 - Challenge: Control strategy
 - Initial assessment using simplified cabin model
 - Tuning of cabin temperature and panel temperature
 - Findings transferred to HVAC control logic



➔ Virtual tools used to prepare creation of control strategy

A virtual user-centric approach UTILISATION OF VIRTUAL TOOLS

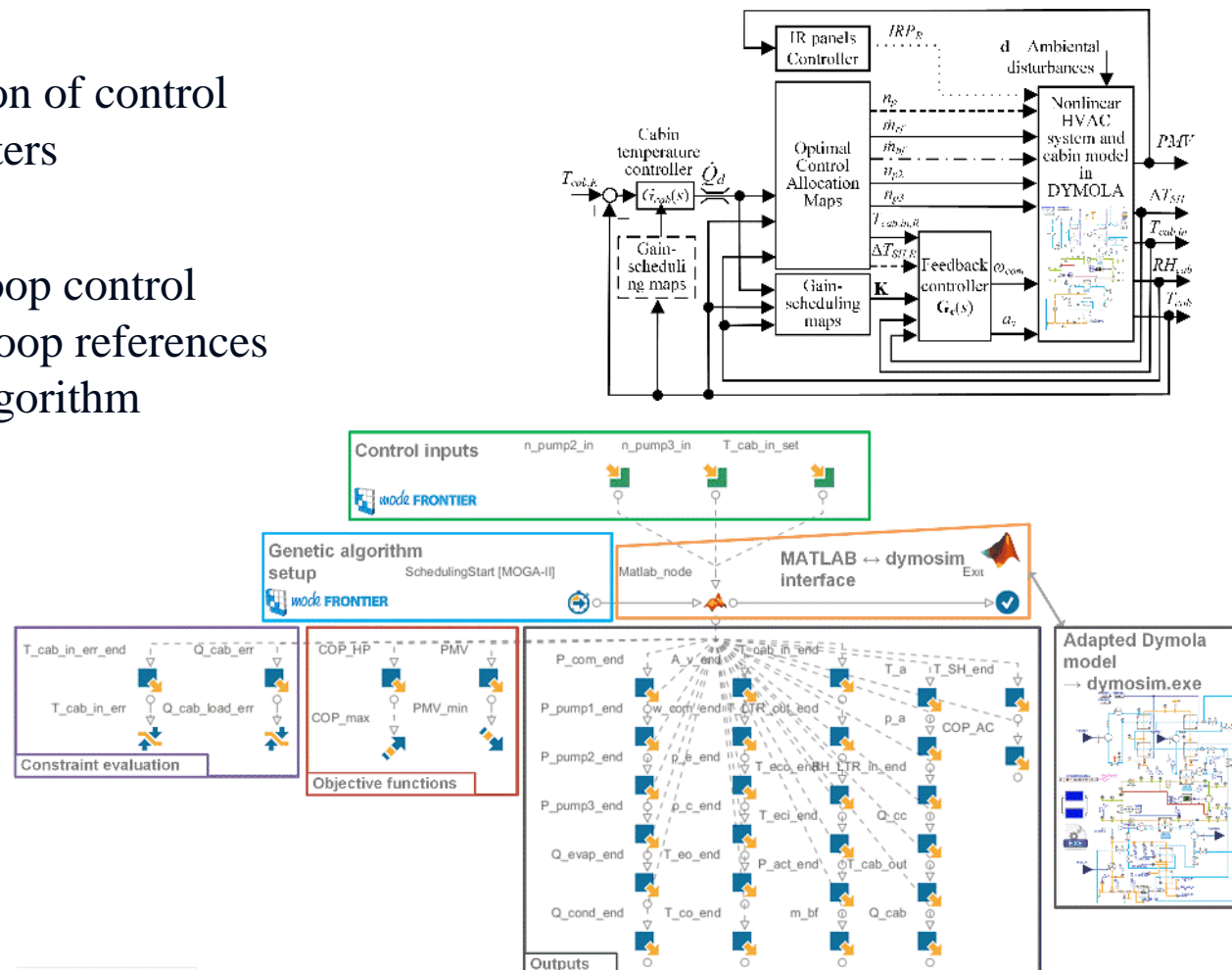
- Virtual assessment of passenger thermal comfort in static conditions
 - Compare 20 °C cabin vs 15 °C cabin with active IR panels
 - Similar thermal comfort
 - Quicker heat up
 - -11% energy consumption over 1h
- ➔ Virtual tools used for initial assessment of effectiveness



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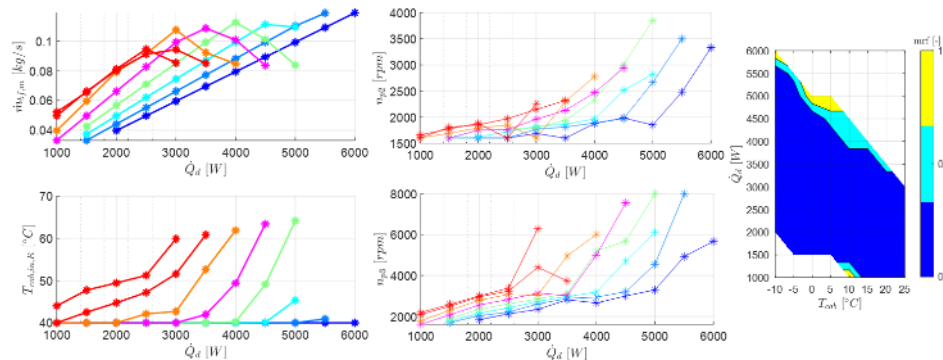
UTILISATION OF VIRTUAL TOOLS

- Algorithmic optimisation of control strategy and its parameters
- Process flow:
 - Optimising open-loop control inputs and closed-loop references by using genetic algorithm

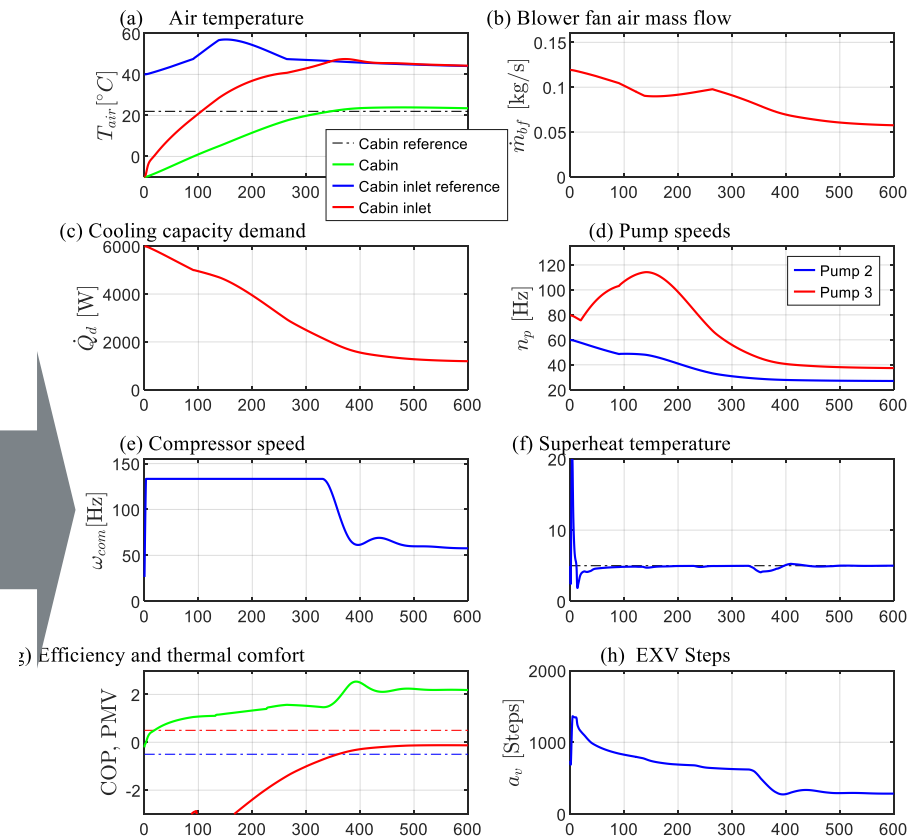


A virtual user-centric approach UTILISATION OF VIRTUAL TOOLS

- Optimal operating points are approximated by analytical expressions
- Creation of optimised allocation maps
- Assessment of system behaviour in virtual environment



➔ Optimisation of system control based on developed virtual tools

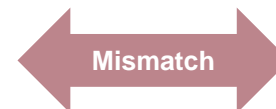


A virtual user-centric approach NOVEL USER-CENTRIC HMI

- New vehicle HVAC much more complex than baseline vehicle

New:

- Complex, Integrated vehicle thermal management system
- IR cabin heating



Previous:

- Electric water heater
- Electric AC system



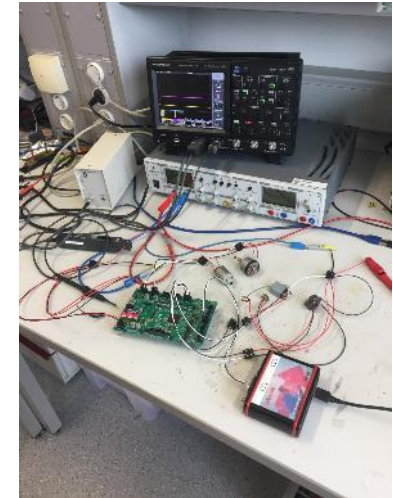
Controls:

- AUTO mode on/off
- Target cabin temperature
- Fan speed
- Air distribution mode
- Air recirculation on/off
- AC on/off

➔ Novel HMI needed to allow easy and efficient usage of new systems

A virtual user-centric approach NOVEL USER-CENTRIC HMI

- Hardware layout
 - System control units
 - Dedicated ECU
 - Actuating components
 - Single board computer
 - Running overall strategy
 - Front-end to user
 - Touchscreen HMI

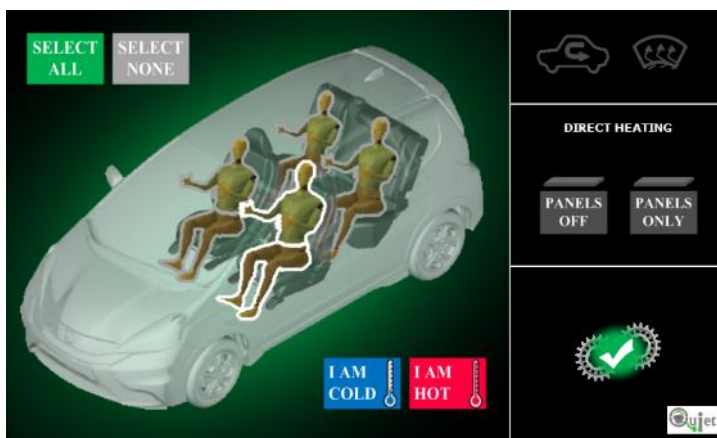


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NOVEL USER-CENTRIC HMI

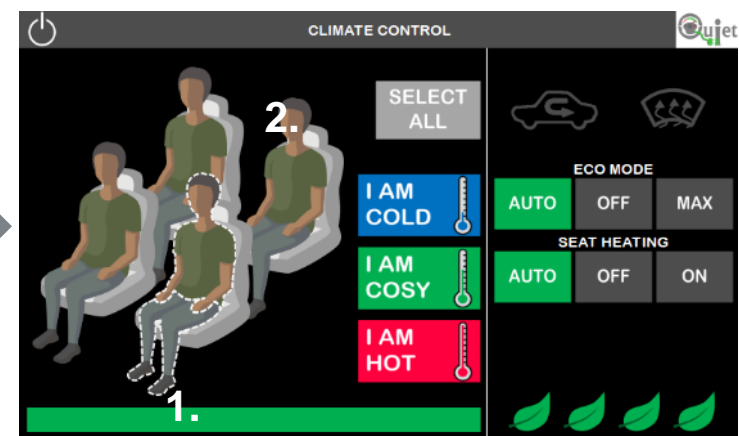
- User centric HMI
 - Iterative development
 - Frequent feedback loop
 - Feedback sourced from
 - Expert feedback
 - Small interim user survey

Initial draft



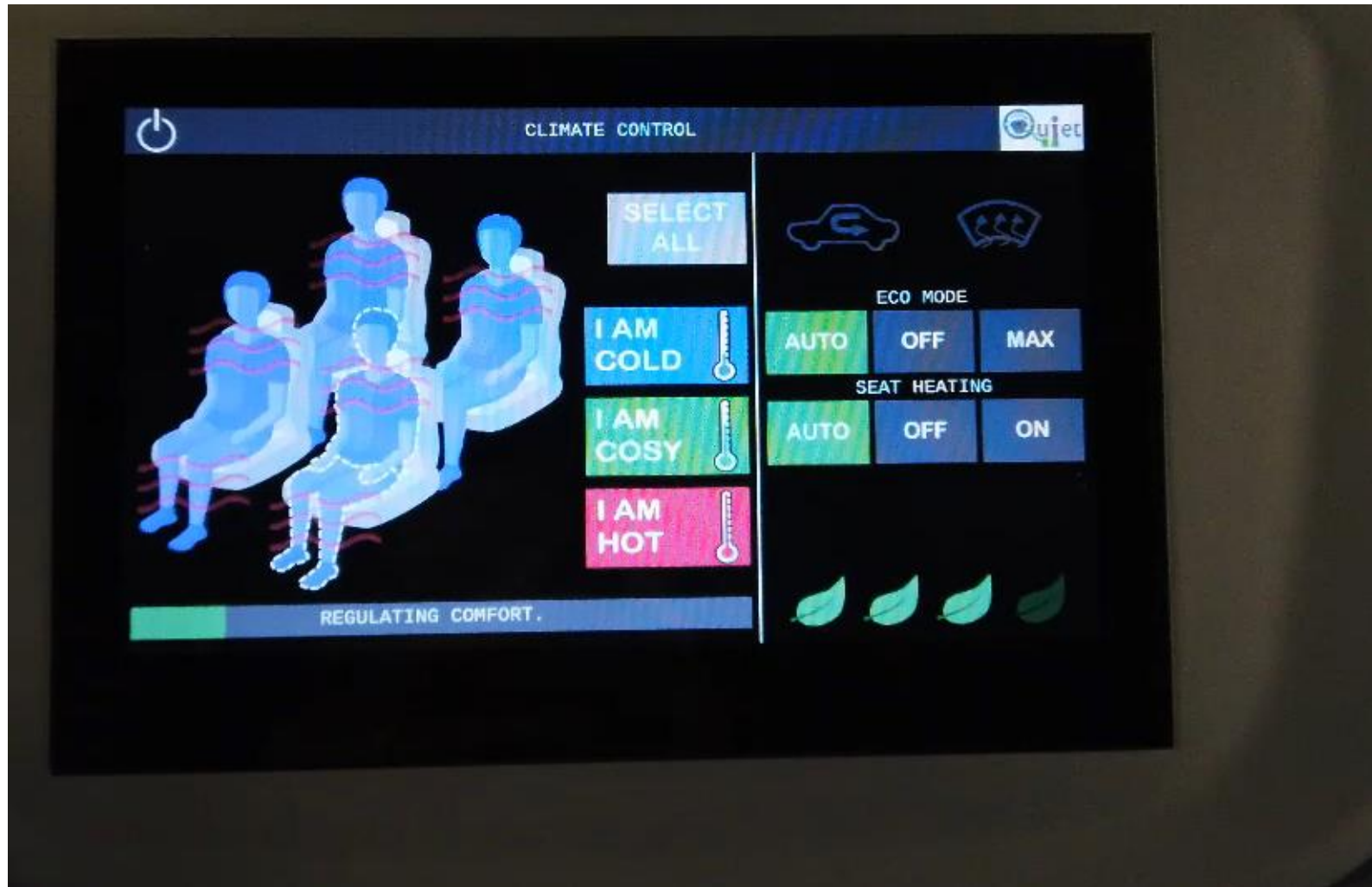
Iterations

Final version



A virtual user-centric approach NOVEL USER-CENTRIC HMI

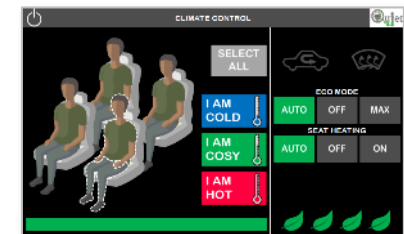
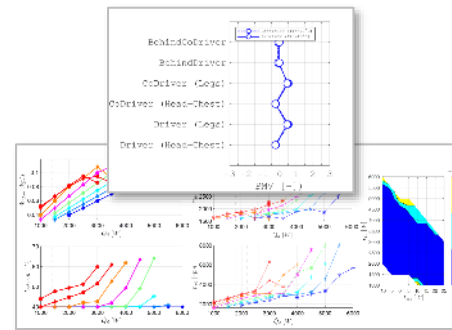
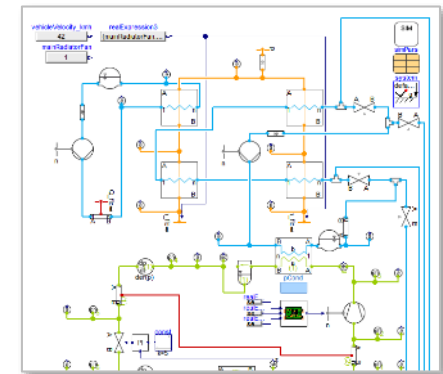
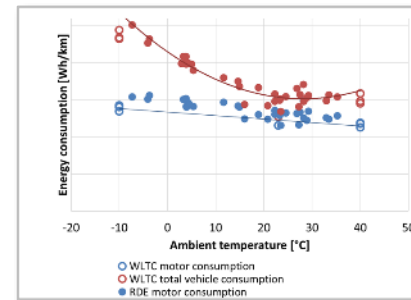
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SUMMARY

- Target setting using real-world data
- Virtual model to prepare HVAC control creation
- Virtual tools used for development of new systems and their controls
- Novel user-centric HMI
- Final user-centric assessment



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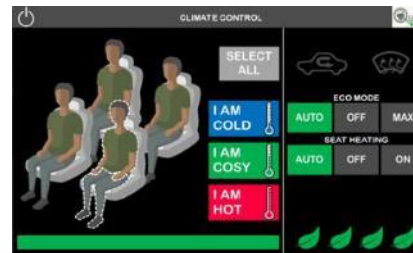
OUTLOOK

- User-centric evaluation by user study
 - Comparing baseline vs demonstrator car

- Assessment items:
 - Subjective thermal comfort
 - HMI usability



VS



VS



A virtual user-centric approach OUTLOOK

- User-centric evaluation by user study
 - Performed on Honda's climatised chassis dyno
 - Combining realism and reproducibility
 - Realistic driver distraction
 - Reproducible climatic conditions



Thank you for your kind attendance.

Steffen JAHN

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