Let's drive innovation together!

IAV Ingenieurgesellschaft für Auto und Verkehr GmbH at a glance …

To: Mr. Buy, CEO of Canadian Ferry Association,
Hamburg, March 18th, 2026

Canadian Ferry Association
Association canadienne des traversiers

Mobility Starts in the Head

For the best mobility solutions, we need the best minds: creative thinkers and passionate doers. At IAV, we combine the competencies from the science community with the hands-on mentality of the industry. Our people are both book smart and street smart. We are transforming from traditional engineering to digital engineering – and help our customers on their journey.

IAV is a leading engineering service provider with over 40 years of experience in supporting top automotive OEMs and tier-1 suppliers

40+ years of experience

6,600 employees at **26** locations worldwide

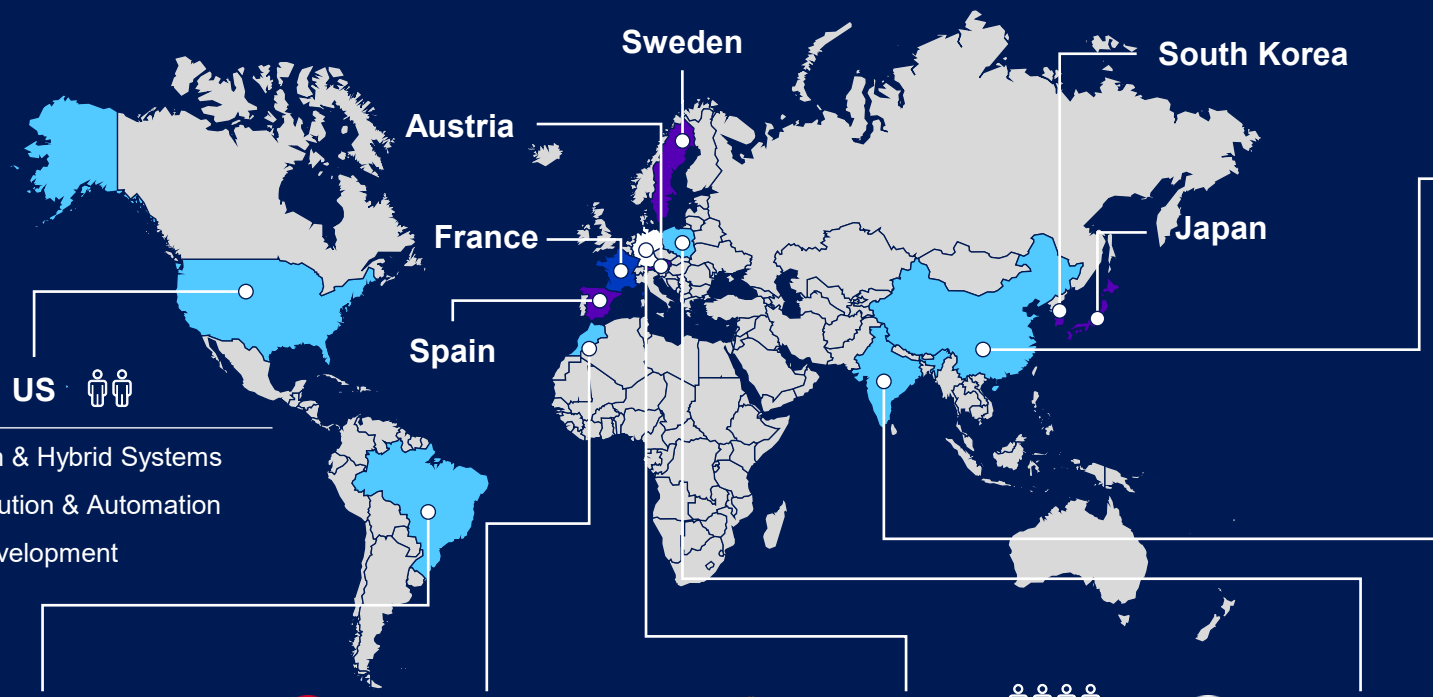
>3,000 projects with leading OEMs and suppliers

>900 M€ revenue per year

Spin-off from Technical University Berlin

Selected IAV customers

Global Automotive Expertise (5,000+ Experts)



Legend

- Sales Office
- Development & Group Service Center

US

- Propulsion & Hybrid Systems
- Test Execution & Automation
- Series Development

China

- ADAS
- Software Systems & Connectivity
- Series Development
- UX/UI

Brazil

- Propulsion & Hybrid Systems
- Test Execution & Automation
- Series Development
- Hardware

Morocco

- Function Development
- Systems Engineering
- Functional Safety
- Software

Germany

- Propulsion & Hybrid
- Fully Electrified Systems
- AD & ITS
- Chassis & Body Electronics
- Infotainment & UX
- SDV Enabler
- Tools & Automation
- Cross Domain Projects

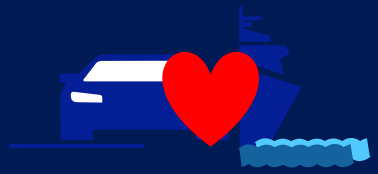
Poland

- Project Management
- Functional Architecture
- Cybersecurity
- Lifecycle Management

India

- Software Development
- Test Execution & Automation
- Cloud & Connectivity
- Function Development

IAV: We are TSP … and yes, we can do it in maritime as well!



Tech-driven

- Research & development
- Concept to series
- Function & calibration
- Hardware integration & chassis
- Safety & security
- Management consulting
- Global project management

Software-defined

- Cloud, services, apps
- Mobile platform
- AI automation
- ADAS
- E2E architecture
- Simulation & virtual testing
- Full E/E domain competence
- AR, VR, computer vision
- Embedded software

Powertrain excellence

- Drivetrain
- Thermal management
- ICE & sustainable fuels
- E-drive
- Battery
- Fuel cell

Source : CFA

Engineering Excellence in Maritime: Simulation and Optimization Solutions

Insights and Value Proposition

Dr. Marcus Perner, March 2026

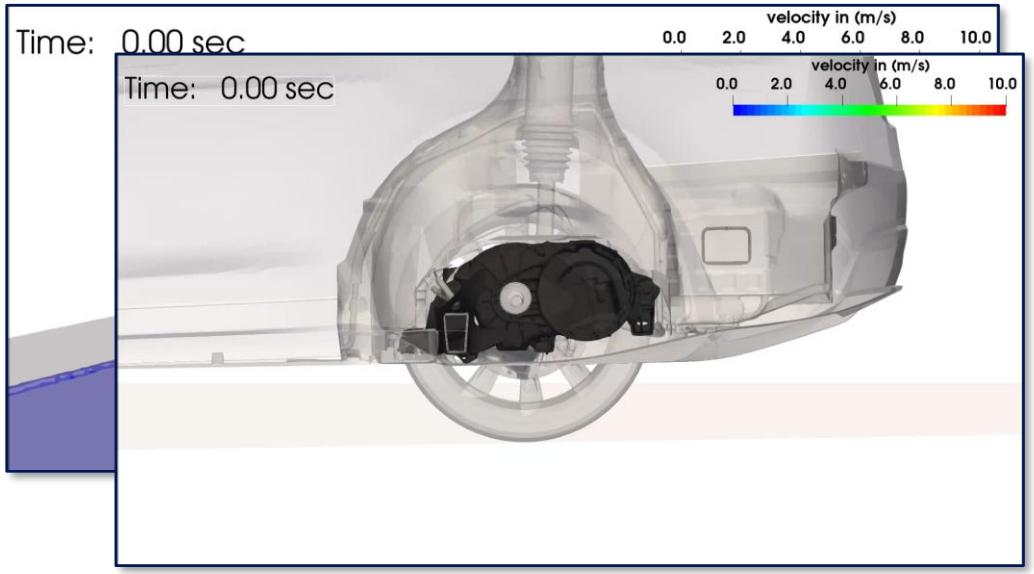
Who are we?

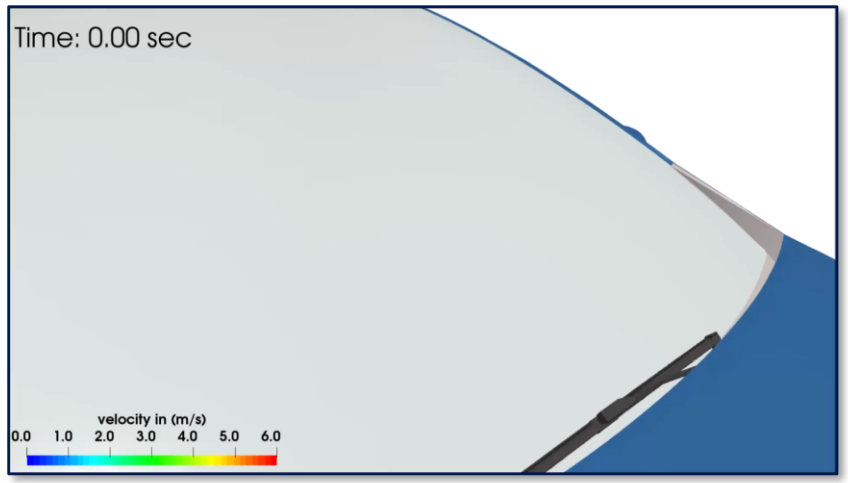
From Mobility Engineering to Maritime Innovation

Mobility Engineering
Simulation of Water Management

Simulation of Water Crossings

- Protection against water damage (e.g., battery)
- Reduction of costly prototype testing
- In contrast to testing, simulation allows detailed analyses (e.g., water paths) and is always reproducible
- Development of optimizations in design and sealing measures





Simulation of engine and HVAC air intake

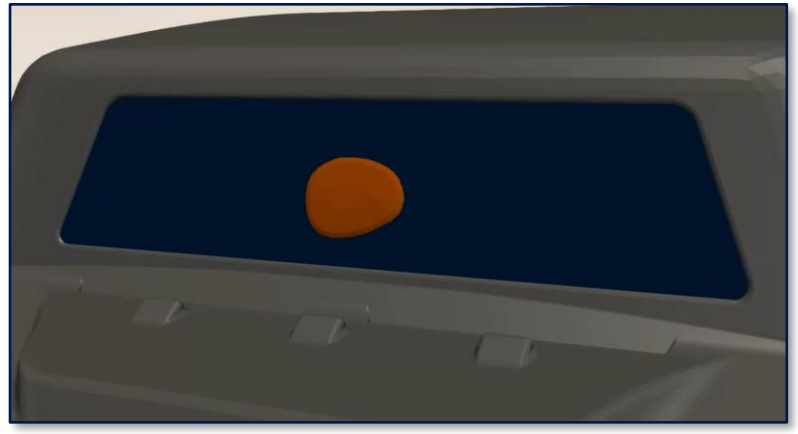
- Simulation of various operating scenarios (e.g., rain intensity)
- Ensuring that the intake air is free of water
- Development of solutions

Mobility Engineering

Sensor Cleaning – Modelling and Solutions

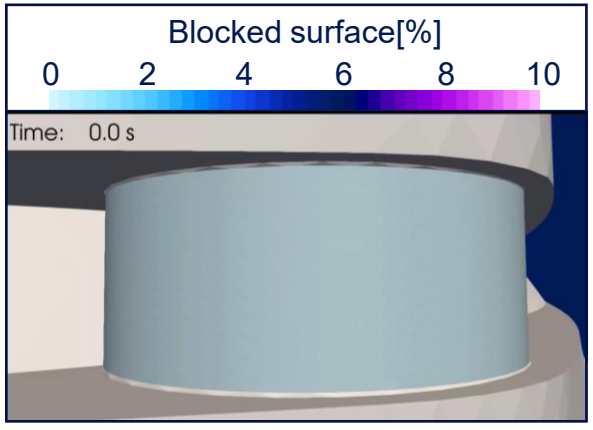
Sensor cleaning systems for autonomous vehicles

- Ensures clear function of cameras, radar, etc.
- Recommendation of sensor positions with low contamination risk
- Development of
  - Cleaning systems and
  - Contamination prevention concepts



Simulated cleaning for an exemplary LiDAR sensor

Simulated dust accumulation for an LiDAR sensor



Concepts for autonomous agricultural machinery

- Simulation of dust accumulation processes and temporal behavior
- Simulation of different types of dust
- Development of solutions to reduce sensor contamination, such as air curtain systems

Maritime Innovation

Simulation Rowing Boat – German National Team

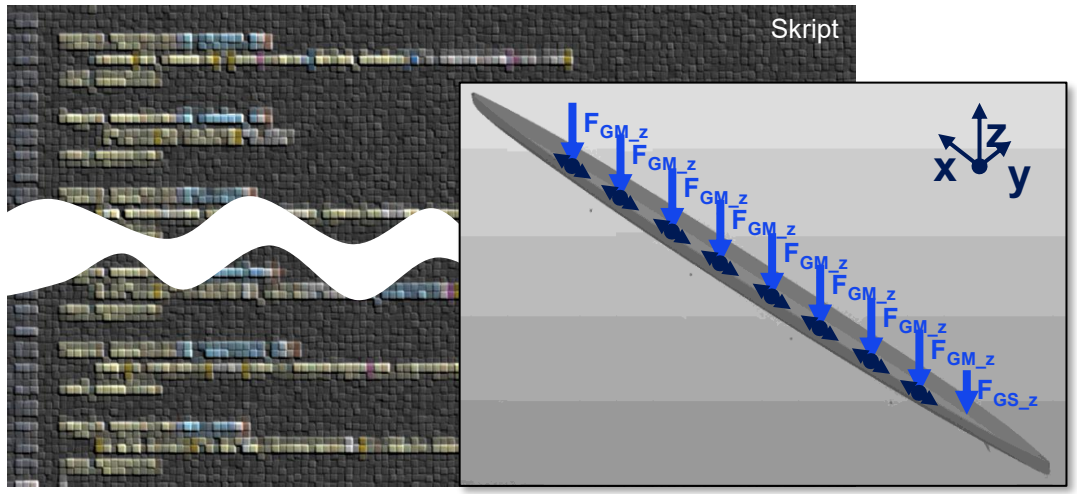
More impressions, currently in use for season 2026 ->

Task

- Simulation of various boat shapes, under consideration of real rowing forces, inertial forces, frictional forces, and boat movement in the water
- Answering the following questions:
  - Which shape is the fastest?
  - How do the boats move in the water?

Simulation

- Model development and physics programming
  - Dynamic rowing forces of the athletes
  - Mass movement
  - Inertial forces of the athletes and the boat
  - Interaction between boat and water
  - Visualization and evaluation tools



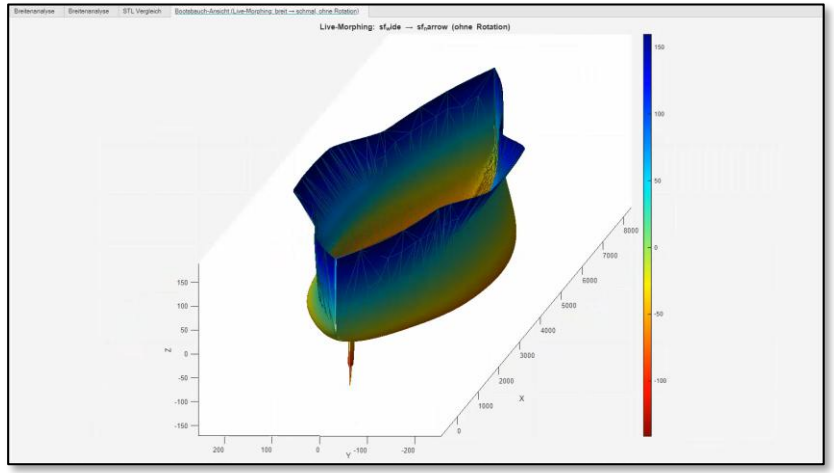
Maritime Innovation

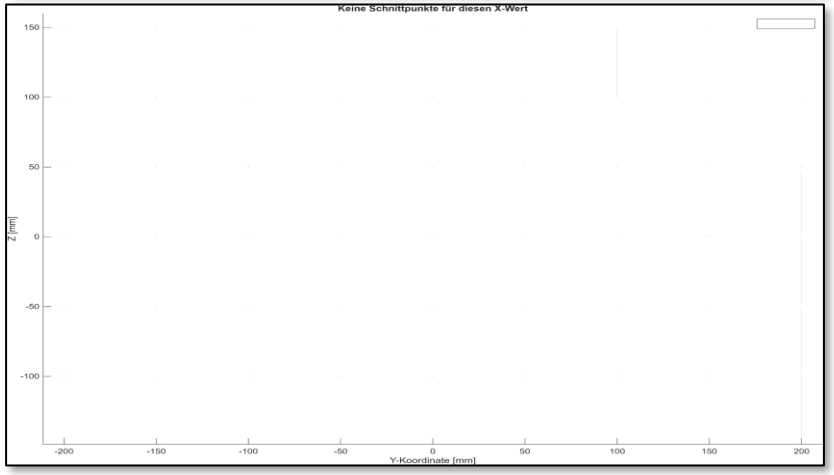
Automated Optimization of Boat Shapes

Current developments

Goal: Automated optimization of boat shapes (Morphing Tool)

- **Input** = initial shape, e.g., existing boat
  - ➢ Automatic optimization based on
    - the results of the flow simulation and
    - the objective functions (speed, movement)
- **Output** = optimized boat shape
- Tool can also be used for development of watercraft
- **Advantages** compared to commercial morphing tools:
  - No black-box model ➔ all effects and results can be traced and explained in detail
  - Maximum flexibility ➔ code can be adapted and further developed for the specific task





Profile from bow to stern

Simulation Methods & Tools

The Foundation for Effective Application

Modelling / Meshing

- Ansa, Hypermesh

Simulation Flow & Thermal

- Star-CCM+
- GT-Suite, Amesim
- Preonlab, MESHFREE

Simulation structural

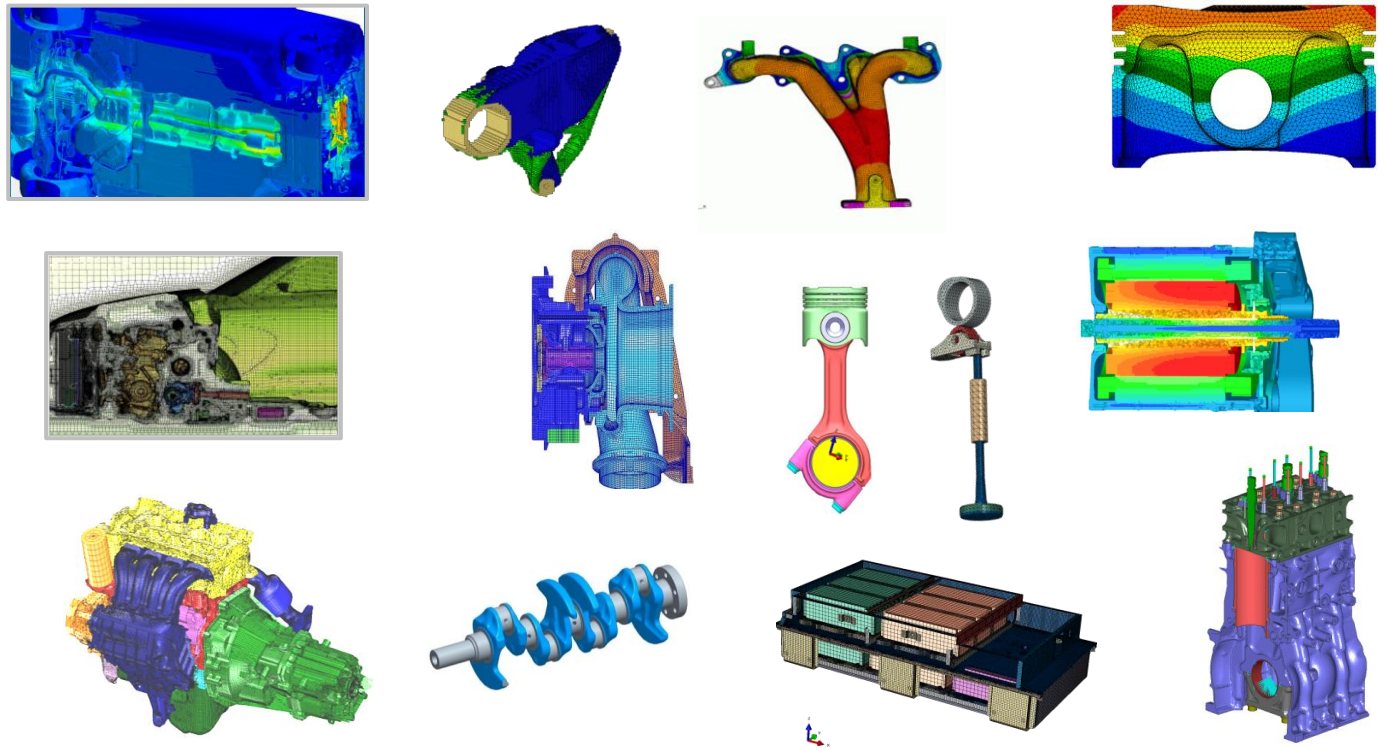
- Abaqus, Ansys
- Femfat, LSdyna
- Optistruct
- MotionSolve

Acoustics

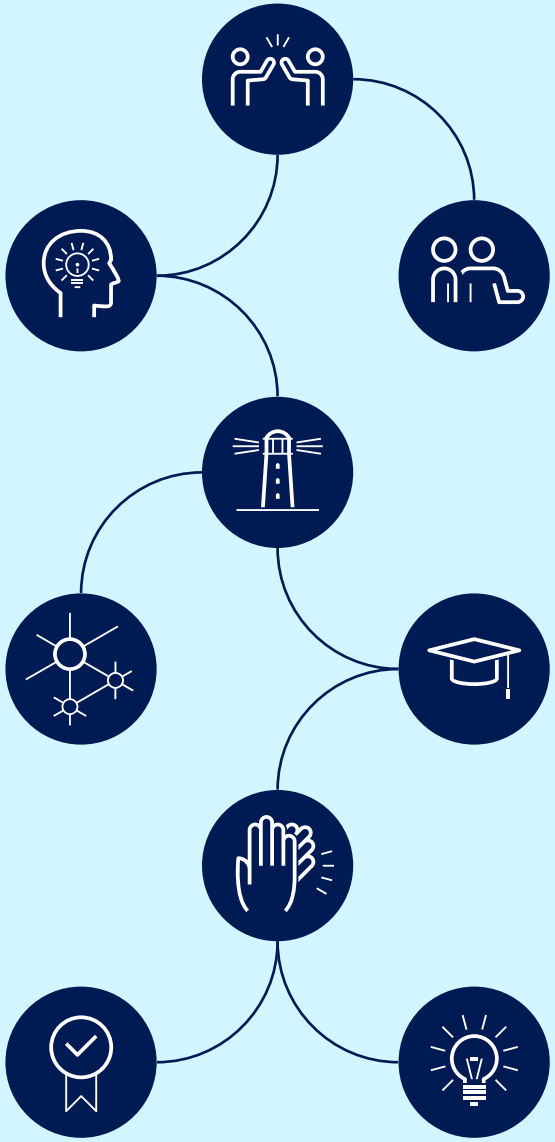
- MGLET, IAV SBNoise

MBS

- SimPack, SimulationX
- SimDrive, Adams



IAV leverages a proven suite of simulation tools, selected and applied with deep expertise and clear purpose to deliver customized, solution-focused results.



Elevating Standards
Our Certifications and Your Assurance

IAV – Renowned for excellence in certification and awards!

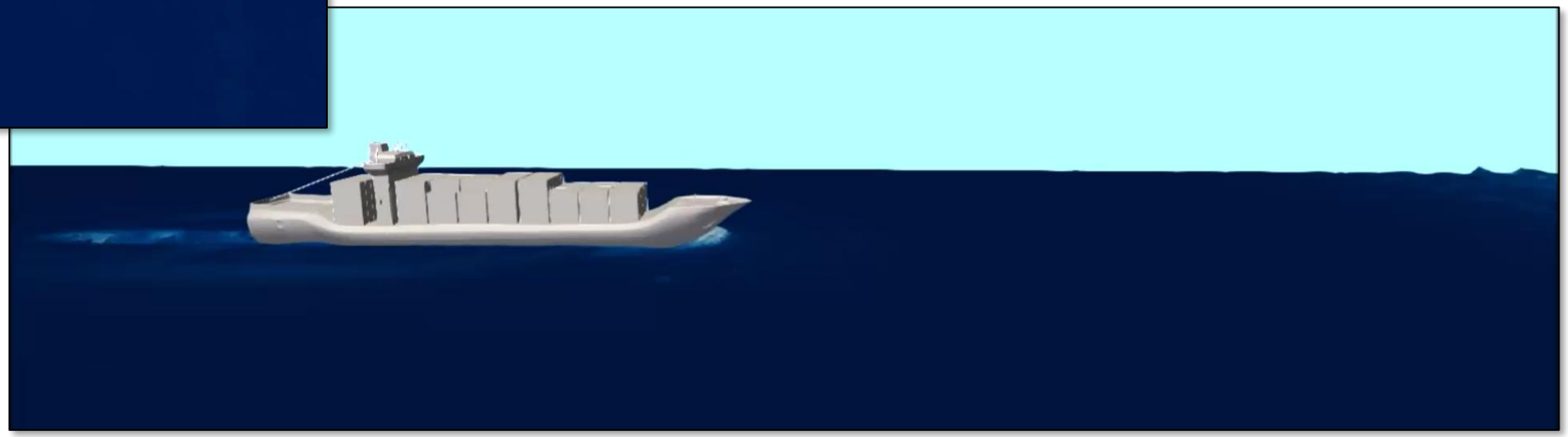
- IAV owns certification related to several standards, e.g.:
  - Cyber Security Management System **ISO/SAE 21434**
  - Employee qualification program **IEC 61508**
  - Information Technology – Security techniques **ISO/IEC 27001**
  - Trusted Information Security Assessment Exchange (**TISAX**) **VDA ISA**
  - Compliance with **Open Source** License OpenChain **ISO/IEC 5230**
  - Quality Management **DIN EN ISO 9001:2015**
  - Environmental Management System **DIN EN ISO 14001:2015**
  - Several Test Laboratory **DIN EN ISO IEC 17025:2018**

Certification with confidence
Empowering your success through proven systematic strategies!

Value Proposition
Project Ideas

- **Simulation and evaluation of watercraft designs, e.g., with regard to speed, maneuverability, and movement in the water (yawing, rolling, and pitching)**

Simulation of the maneuverability of a container ship in rough seas (programmed wave generator)

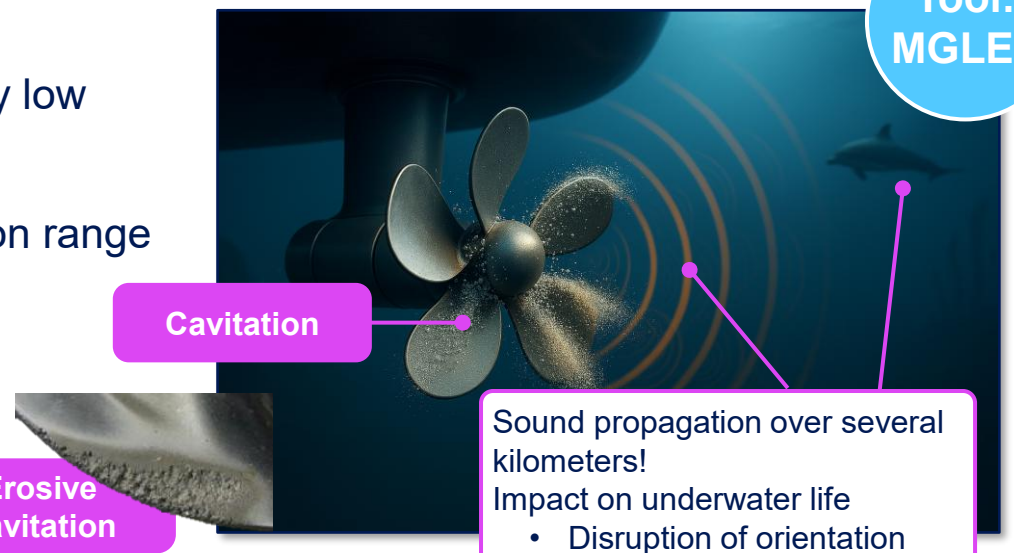


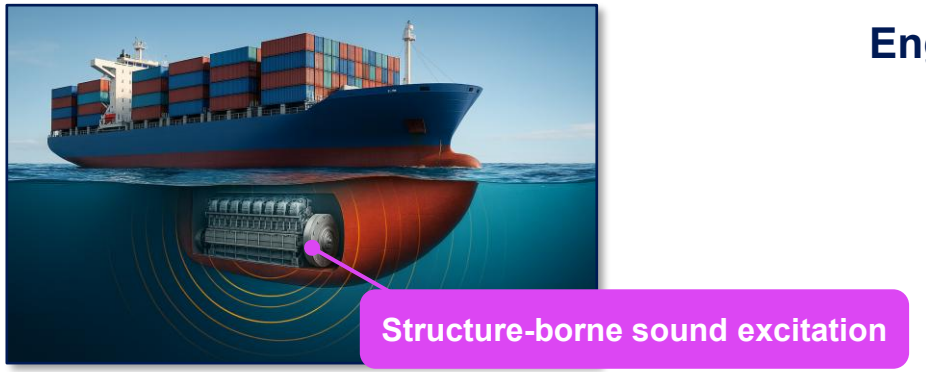
Underwater Acoustics

Use Cases and Potential for Added Value

Propeller

- **Cavitation:** Vapor bubbles that implode due to excessively low pressure on the underside of the blade
  - ➢ Primary source of noise with a long acoustic propagation range
  - ➢ Detection of components with cavitation potential
  - ➢ Virtual speaker point as cavitation sound source
- **Propeller singing**: Flow vortex shedding frequency
- **Flow noise** caused by turbulent flow



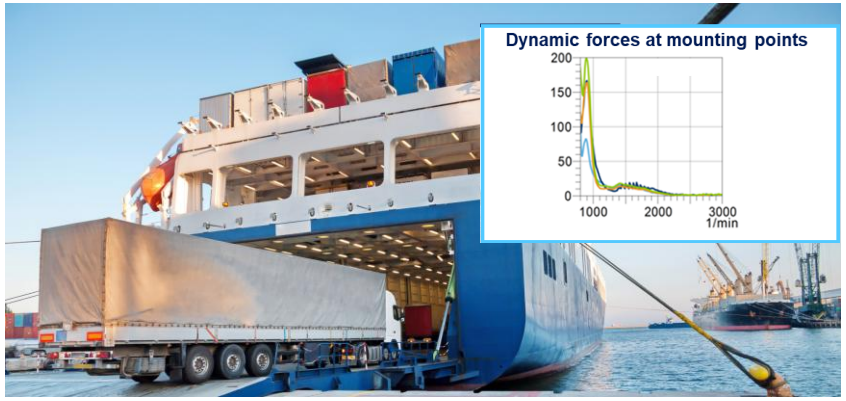


Engine and Drivetrain

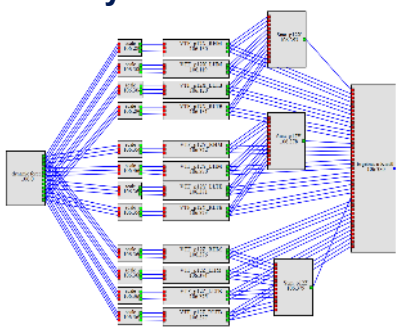
- Stationary, cyclic unbalanced forces caused by multi-body motion:
  - Coupling of structure-borne noise into the ship's structure
  - Little hull sound insulation ➔ rapid transmission into water
- MKS & FEM simulations incl. structure–fluid coupling (AFSI)

Low and Medium Frequency NVH Behavior

Analysis of the Transmission behavior

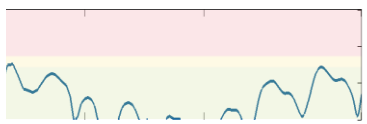


TP Synthesis network



Paths / Positions

Rating TF



Development goals

- **NVH assessment** of the transmission behavior of structure-borne and airborne sound

Services

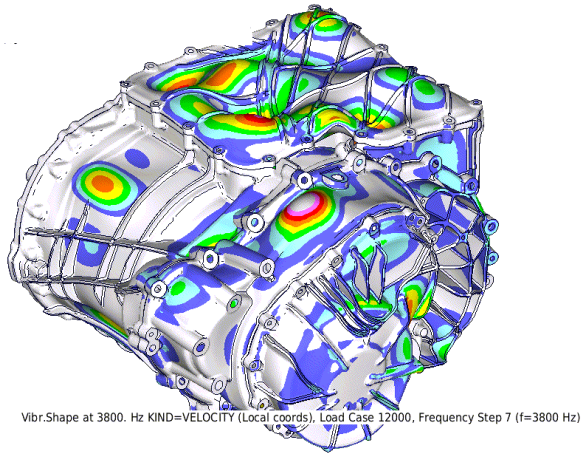
- Transfer of body-side bearing forces from MBS simulation
- **Creation of a network of all paths as transfer paths using software**
- Preparation of measured or calculated transfer functions (TF)
- Analysis of the transfer functions in comparison with IAV database values
- Evaluation of the transfer functions datum of target values
- Development of optimization measures for the NVH behavior of the drivetrain
- Preparation of report and transfer of data

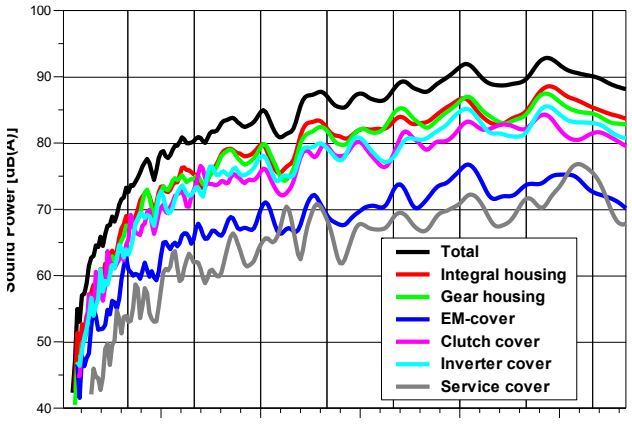
Results

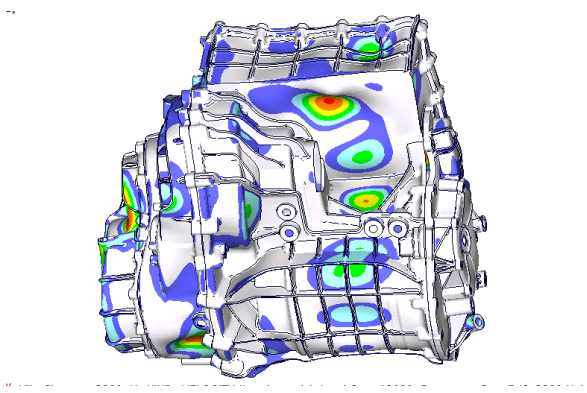
- Evaluation of the transfer functions / body sensitivities
- Evaluation of bearing forces before / after bearing (powertrain, …)
- Assessment of structure-borne noise
- Evaluation of Vibration Dose Values (VDV) for transient load cases

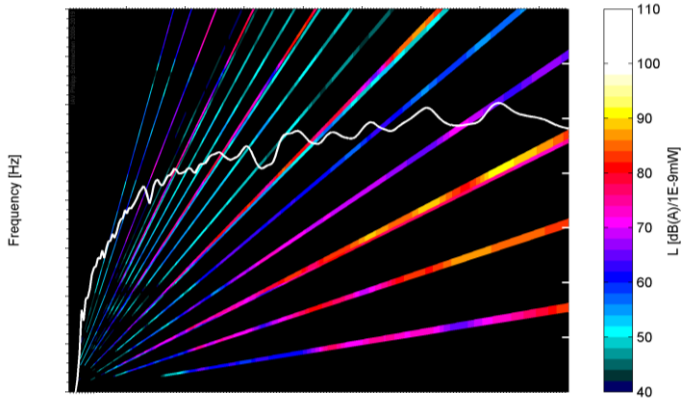
Medium and High-Frequency NVH Behavior

Linear Structure Dynamics









Calculation

- Starting up the drivetrain
- Display of partial noise sources, e.g. covers, housings in comparison to the overall noise
- Comparison with the target database
- Creation of sound files for body and airborne sound
- Separation of acoustically critical parts

Optimization

- Enclosure: Sound radiation, shaft deflection, load paths
- Optimization of transmission paths:
  - mountings and brackets
  - bearing rigidity

Value Proposition
Project Ideas

Our Value Proposition – Bringing added values for your projects!

- Optimization of watercraft designs, e.g. to
  - Reduce fuel consumption,
  - Increase the speed and
  - Improve of maneuverability in rough seas
- Analysis and evaluation of watercraft acoustics
- Optimizations of the acoustic behavior
- Evaluation impact of engine adaptations to the underwater NVH characteristics
- Benchmarking, Market landscape analysis

Kontakt

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Prof. Dr.-Ing. habil. Wolfram Gottschalk (CSE-B),
IAV GmbH

To: Mr. Buy, CEO of Canadian Ferry Association,

Canadian Ferry Association
Association canadienne des traversiers

Maritime application on sustainable FAME … “canola”

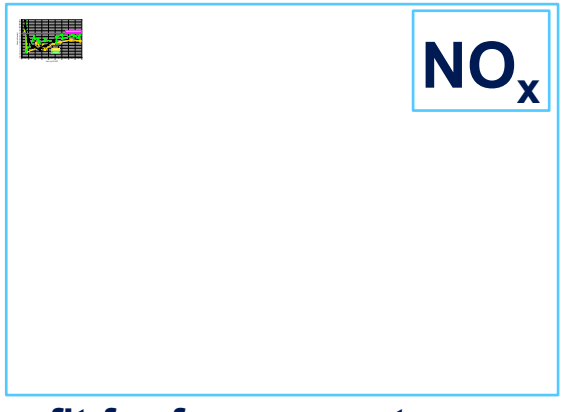
Source: IAV GmbH

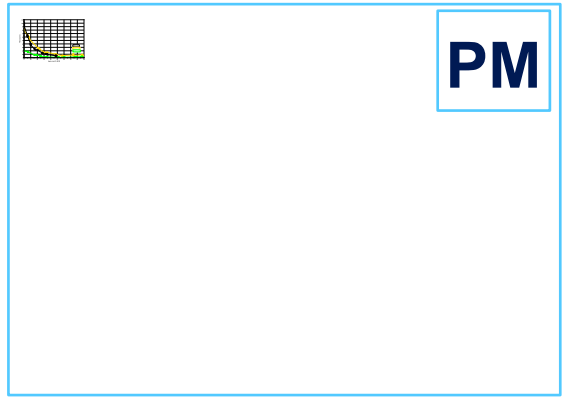
Trustable machinery compliance

- IAV performed full on-engines data acquisition on combustion & emissions
- IAV results have been successfully certified by IMO, DNV and flag state
- No mechanical or fuel system issues been found by IAV and operator

Clear climate& environmental protection progress

- NO_x identically recertified (IMO Tier II rating extended to FAME)
- PM drastically reduced with major benefits for transient and harbor





FAME is the optimum short-term CO_2 reduction option for vessels!

Benefit for ferry operator

Max CO_2 saving ↗ short-term availability ↗ “Canola” Canadian “local” fuel ↗

Fuel identification on sustainable diesel (i.e. FAME, HVO)

Knock Sensor

- The synchronized noise-pattern of the engine provides information about the combustion process
- Dedicated IC on ECU pre-processes the high speed noise signal of the sensor
- Sensor is uncommon for Diesel engines but provides synergies regarding CBM

Image-Source: https://www.bosch-mobility.com/de/loesungen/sensoren/klopfsensor/

Handling fuel variations

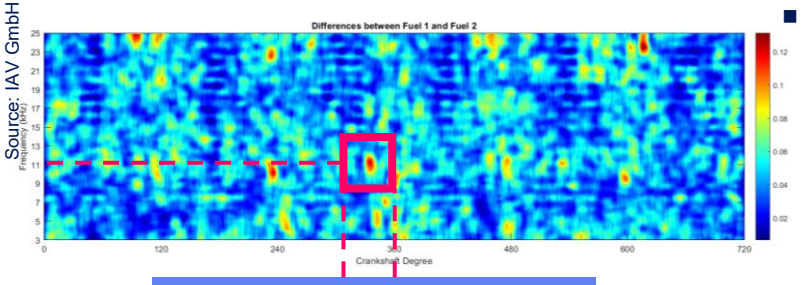
- IAV tested a state-of-the-art combustion identification technology sucessfully
- IAV can retrofit this sensing system to engines in service
- The sensed findings will be fed into the engine control

Clear climate& environmental protection progress

- Sustainable fuels will be reliably identified i.e. for CO_2 control schemes
- The engine control adjusts automatically for best fuel economy
- Sustainable fuels can be applied flexibly following availability and costs

Benefit for ferry operator

- Max CO_2 saving ↗ self-adjusting engine control ↗ data for incentives ↗

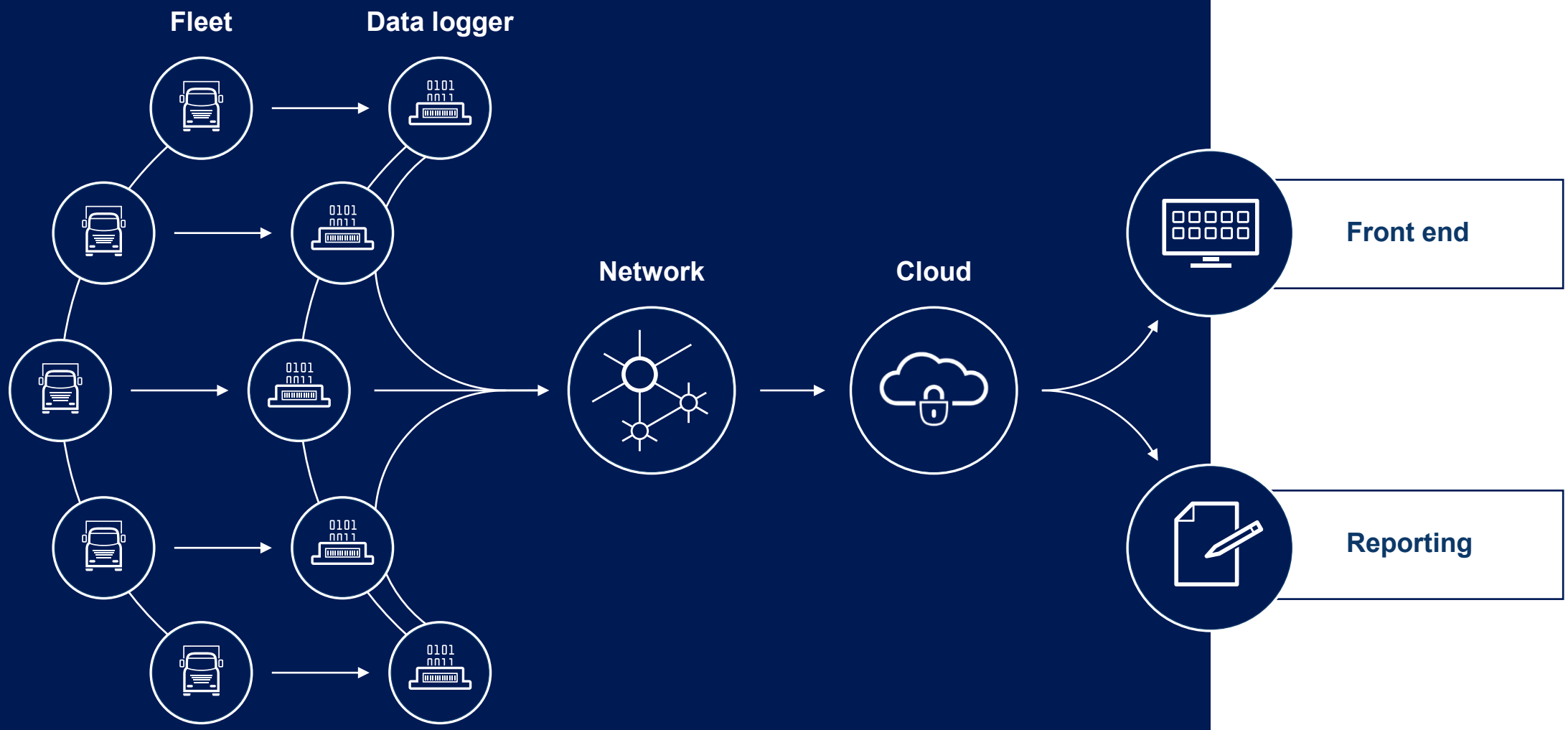


Source: IAV GmbH

Area w/ strongest separation for fossil diesel vs. FAME

A fuel identification system will enable multiple degrees of freedom for the ferry operator including CO_2-saving incentives!

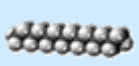
Fleet Diagnostics



Fleet Diagnostics

Well-proven for trucks and tractors already it will work successfully for vessel fleets as well!

Sustainable low-flashpoint fuels (i.e. alcohols & BioCNG)

	Fossil diesel	Bio xNG	Methanol (synth., bio)	Ethanol (synth., bio)
Molecule				
Rel. CO_2	100%	< 20%	< 15%	< 15%
Vol. Energy	100%	23% (g) 61% (l)	45%	60%
Risk to water	★	★	★	★
Handling effort	★	★	★	★
Power output potential	★	★	★	★
NO_x & PM reduction	★	★	★	★

Source: IAV GmbH

Next fuel sustainability step beyond FAME & HVO

- IAV has clear insights that the long-term fuels will be “low flashpoint”
- The IGF code will be mandatory for sea-going units, IWW can adapt
- Liquid fuels are still to be preferred → alcohols (i.e. methanol & ethanol)

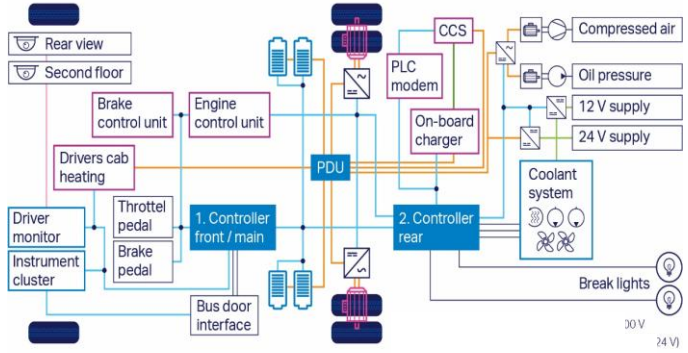
Clear climate& environmental progress with technical efforts

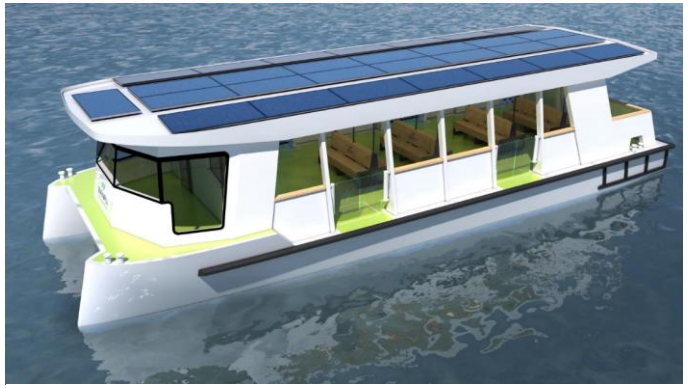
- DF engines already available but highly complex i.e. for smaller ferries
- Engine manufacturers do not clearly support smaller units < 1MW so far
- IAV can contribute to bridge this technical gap by knowledge transfer from i.e. land-based commercial propulsion systems
- IAV can deliver adaptable controls solutions for fuel flexibility

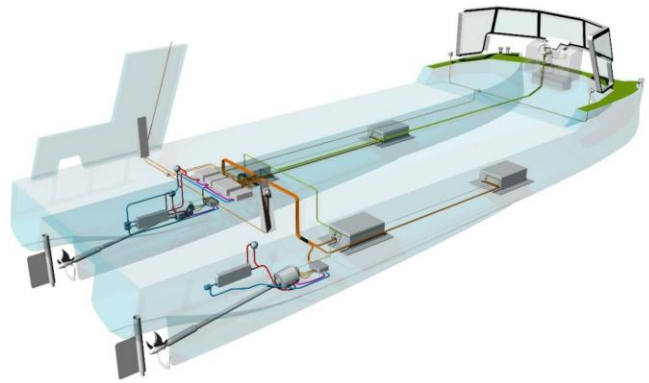
Benefit for ferry operator

- Long-term CO_2 compliance ↗ fuel flexibility ↗ local emissions reduction ↗

Long-term sustainable fuel option are low-flashpoint fuels!







Source: IAV GmbH

Maritime / ferry electrification with MBSE

Increasing complexity & shorter innovation cycles

- From component oriented to software defined vehicle
- Electrification, autonomous, connectivity, sharing
- Standards (i.e. ASPICE) & norms (i.e. ISO26262 & ISO21434)

Managing complexity with (MB)SE

- Function-oriented development combining requirements and architecture
- Orchestration of increasing dependencies between software, electronic and mechanical systems
- Key roles: Requirements Engineer, System Architect, Systems Engineer

Benefit for Customer

- Traceability & quality ↗, time to market / risks & costs ↘

MBSE as efficient method for cross-domain system development → vessel electrification as main target application

Contact

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