How can we transfer the RDI/automotive knowledge into the other business areas

Gábor KIGLICS
CEO – eCon Engineering

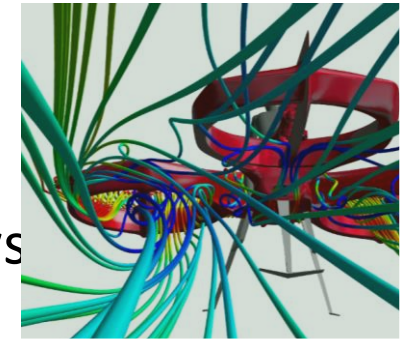
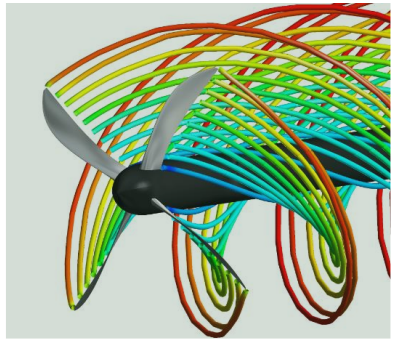
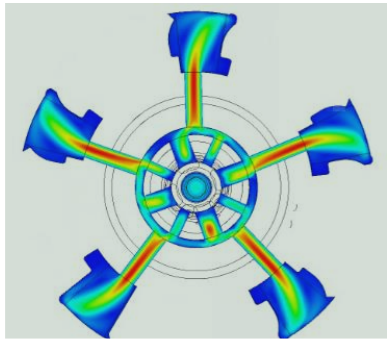
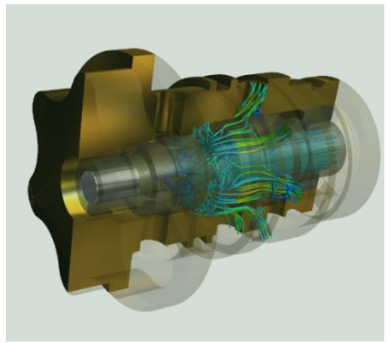
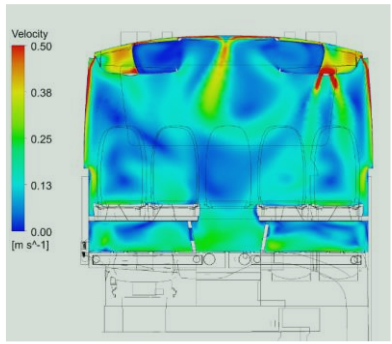
2021.01.21

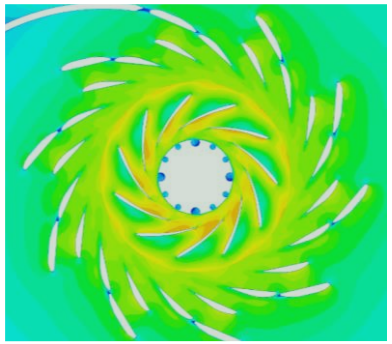
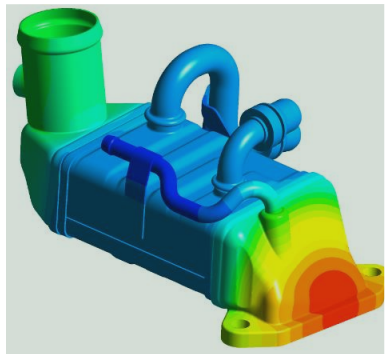
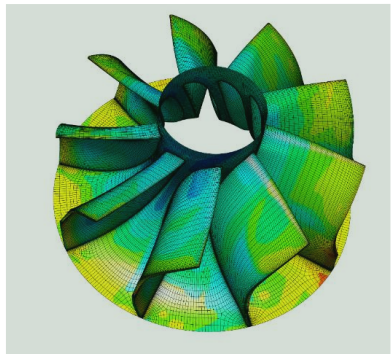
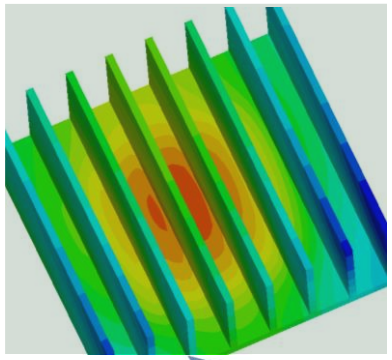
Intro & Business Model

- Foundation: 2002
- Independent engineering consulting company for
  - Engineering consultancy
  - Cooperative engineering
  - RDI
  - High-added value support
- Regarding business fields
  - Automotive
  - Aerospace
  - Composite
  - Construction
  - Healthcare
  - Energy industry
  - Agriculture
- Computer Aided Engineering – CAE
  - Finite Element Method
  - Computational Fluid Dynamics
  - Multi Body Systems
  - Electromagnetics
  - 1D System Simulations
- Machine Design – automation
  - Production Technology
  - Automatization Robotization
  - Single-Purpose Machines
  - Robot Cells and Testers
- Software Distribution
  - Ansys Channel Partner
  - Moldex3D Reseller
  - Cast-Designer Reseller

CFD & 1D simulations

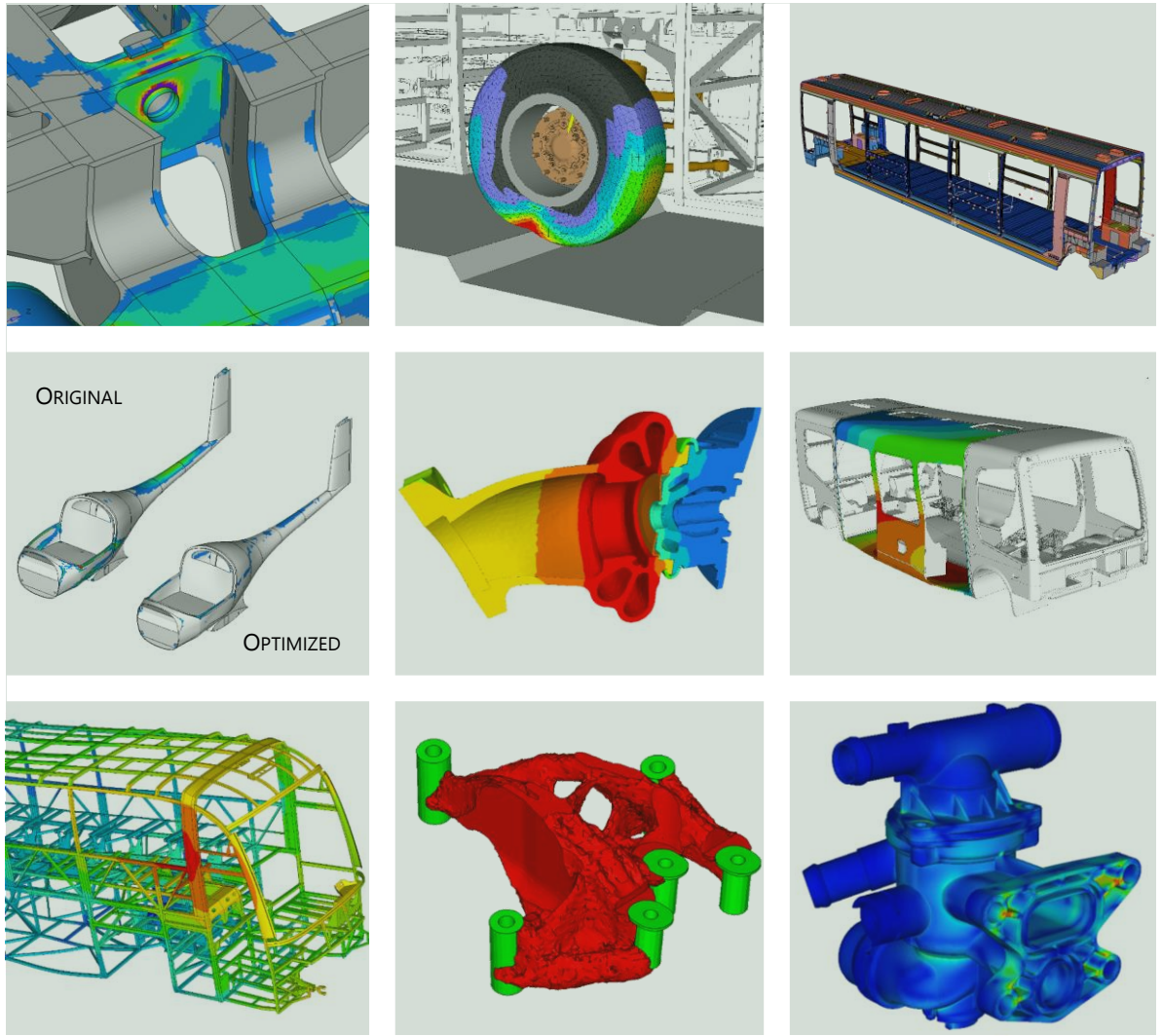
- Rotating machines
- Internal flow
- Multiphase and multicomponent flows
- External aerodynamics
- Conjugate heat transfer
- HVAC systems (1D and 3D)
- Fluid Structure Interaction
- 1D System simulations

FEM simulations

- Model building
- Static, linear calculations
- Thermomechanics
- Durability and fatigue
- Topology optimization
- Non-linear problems
- Low and high speed crash
- Composite structures
- Multibody simulations
- Noise, Vibration and Harshness
- Low- and high-frequency electromagnetics
- Programming in Python

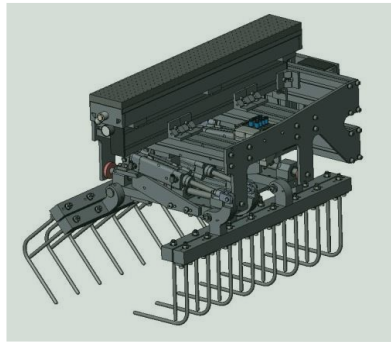


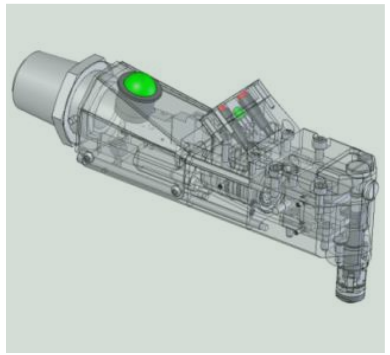
Automation

- Robotics & assembly stations
  - Pick&place stations
  - Screwdriving stations
  - Press-fit equipment
  - Crimping stations
  - End of line testers
  - Orbital riveting stations
  - Visual testers
- Material handling
  - Conveyor systems
  - Balancer systems
  - Special grippers
- Robot cells
  - Palletising and depalletising
  - Grinding
- PLC programming



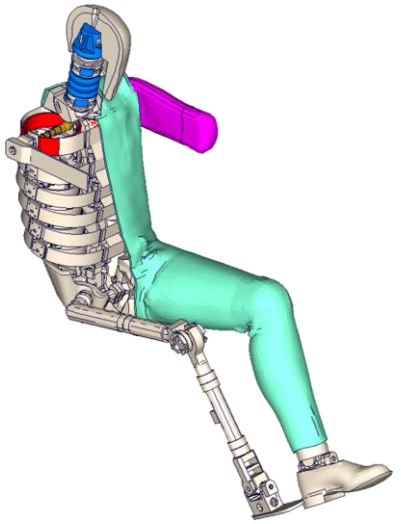







BMW Virtual Dummy Laboratory – overall concept

The task of the Virtual Dummy Laboratory is dummy **development, integration and quality assurance of** all dummies in all vehicle projects.



100+ measurement channels

- Acceleration
- Angular Velocity
- Displacement / Angle
- Force / Moment

Development:

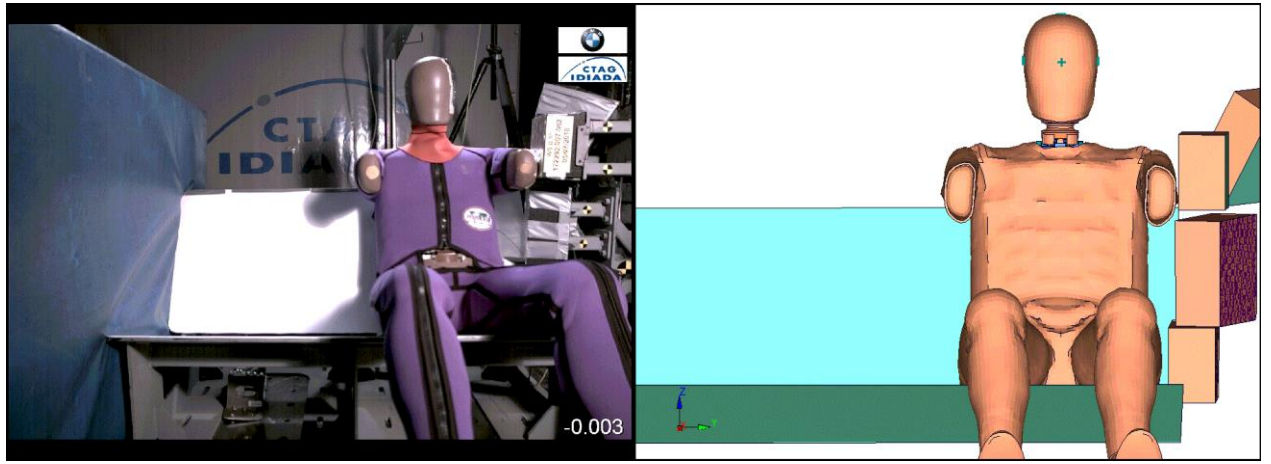
- **Centralizing** all dummy model tasks
- Transparency in **prognosis quality**
- Determination of need for action
- **Validation**/certification with standard and BMW-specific load cases
- **Open access** for dummy model suppliers

Integration:

- **Integration** to BMW environment
- Managing cooperation with suppliers

Quality assurance:

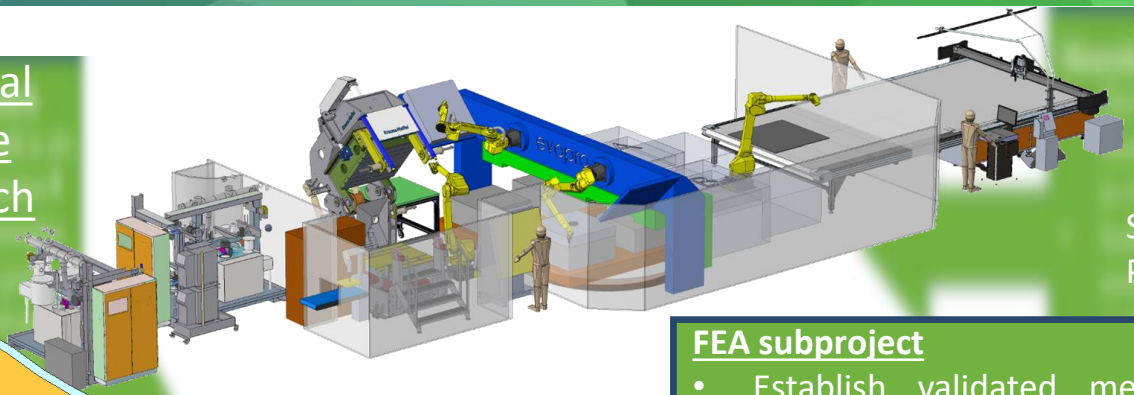
- **QA process** when changing/updating crash code
- Statistics and forecasting quality improvements



R&D project for thermoplast composite material characterisation

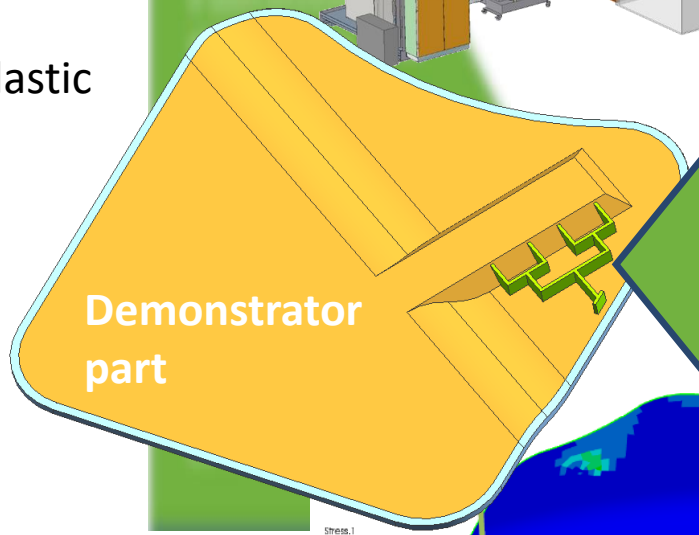
- Development of low cycle time manufacturing process and high-fidelity design procedures of thermoplastic matrix composites for automotive use

Material science research

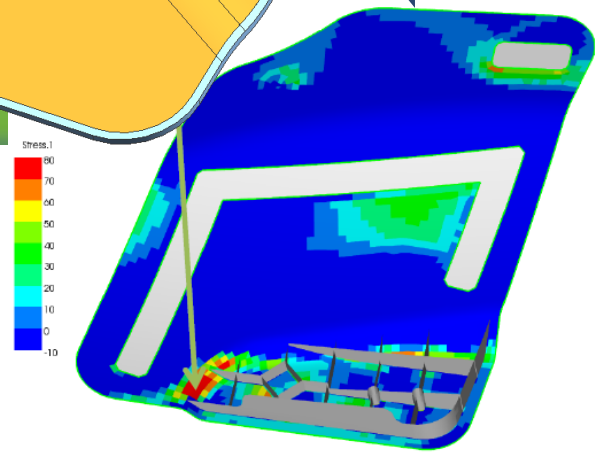


Manufacturing technology subproject

System design work
Process optimisation

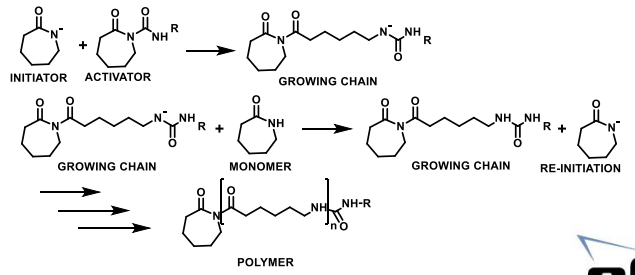


- Material mechanical testing
- FEM based method development



FEA subproject

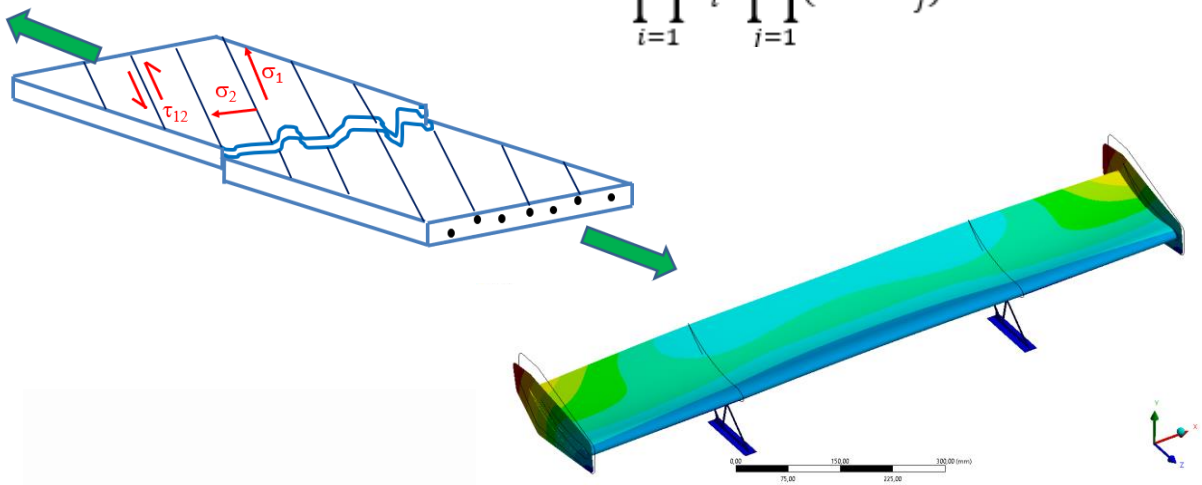
- Establish validated methods to reliably and efficiently predict for any critical feature of a composite product with any stackup sequence and reinforcement structure the followings:
  - Deformation, strength, failure characteristics
  - Fatigue behaviour
  - Structural behaviour (stiffness and strength) of joints (adhesive, rivet etc.)
  - Effect of manufacturing defects on structural characteristics

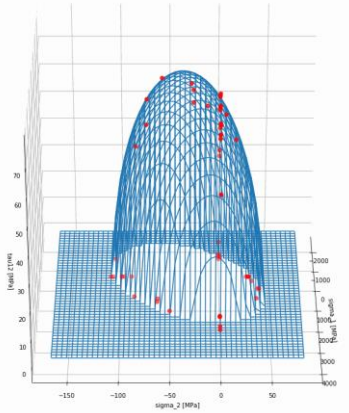


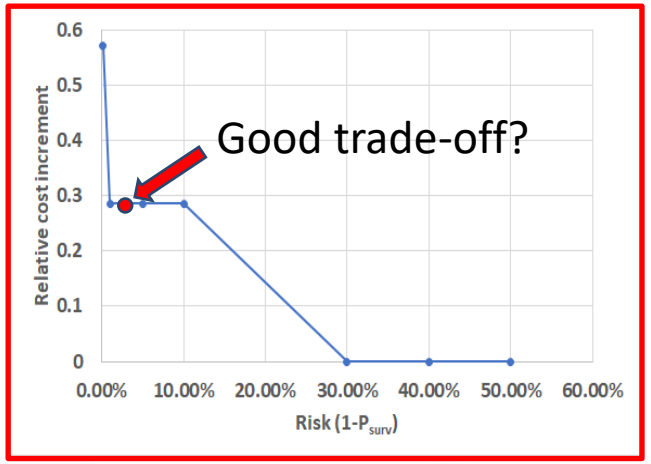
Advanced composite parameter fitting methods

- High-fidelity material parameter fitting processes including UQ and probabilistic methods
- Input: raw test data, output: orientation dependent material model parameters for direct FE use
- Method for direct evaluation of stiffness constants and the variation of them
- Method for direct evaluation of failure model parameters and the variation of them (Tsai-Wu, Puck, Hashin etc.)
- Possibility to derive FE material input corresponding to predefined probability of survival
- Opportunity to compute cost of safety

$$OF = \prod_{i=1}^{N} P_i \cdot \prod_{j=1}^{M} (1 - \Sigma P_j) = max$$

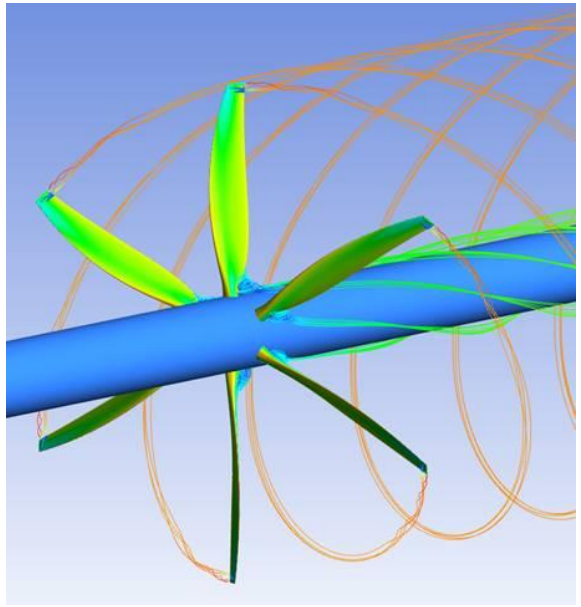


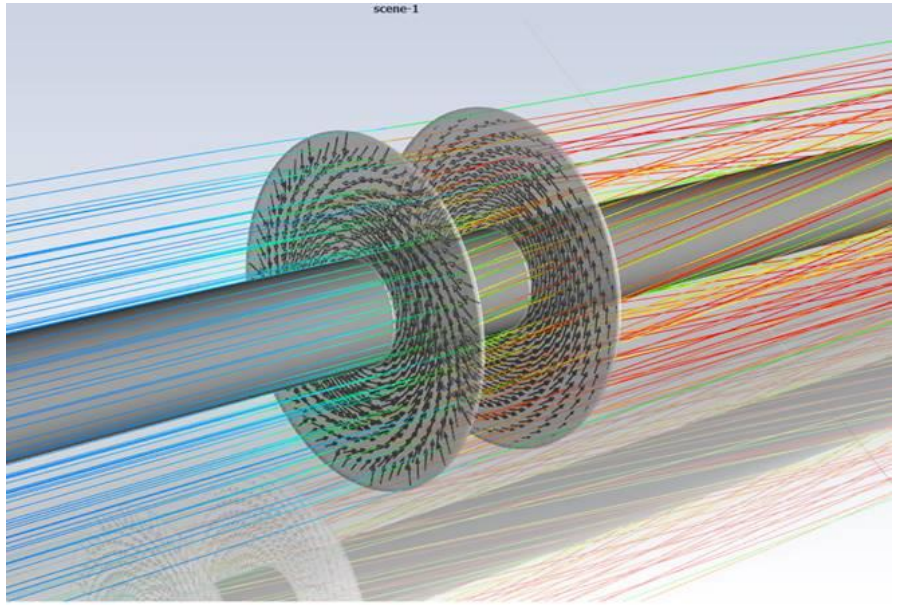


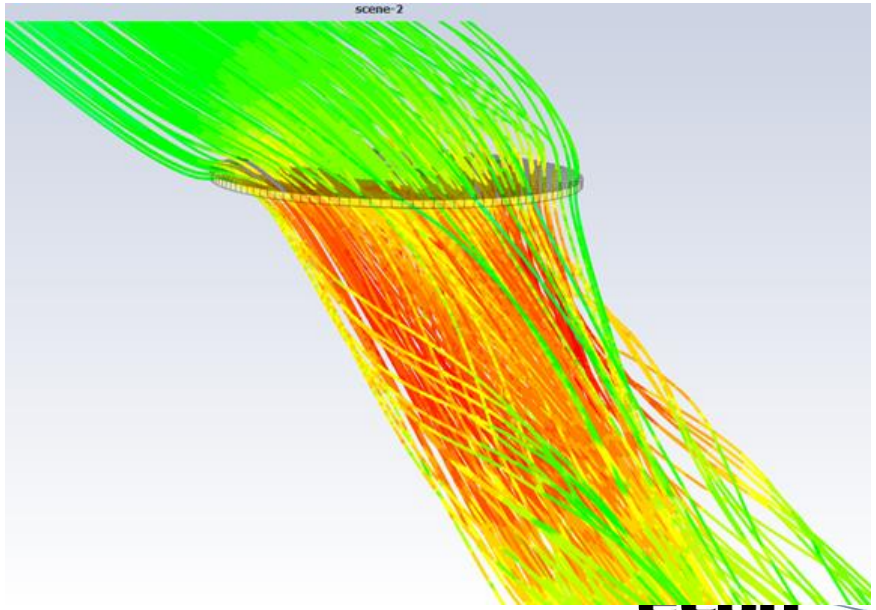


CFD Simulation method and workflow development

- **Development of Virtual Blade Model** (VBM) with built-in 3D aerodynamic correction using artificial intelligence
  - 3 years R&D project founded by the Hungarian government
  - Substitution of explicit propeller models in CFD with VBM to speed up simulations without loosing flow characteristics induced by blades' spanwise 3D load distribution
  - Optimisation of features washed by the propellers' wake becomes feasible

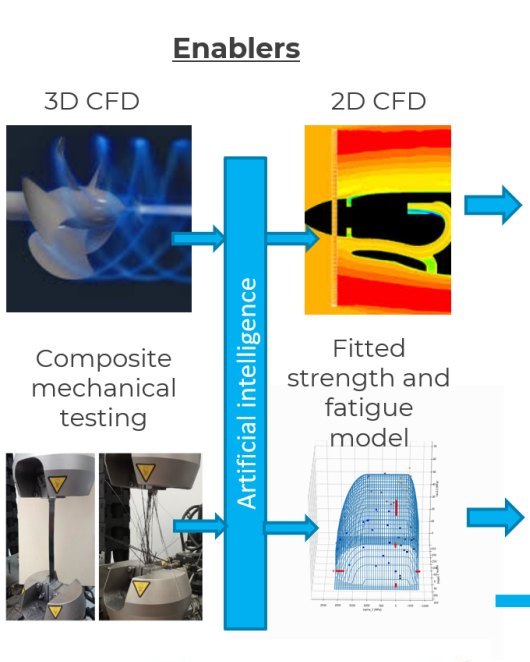


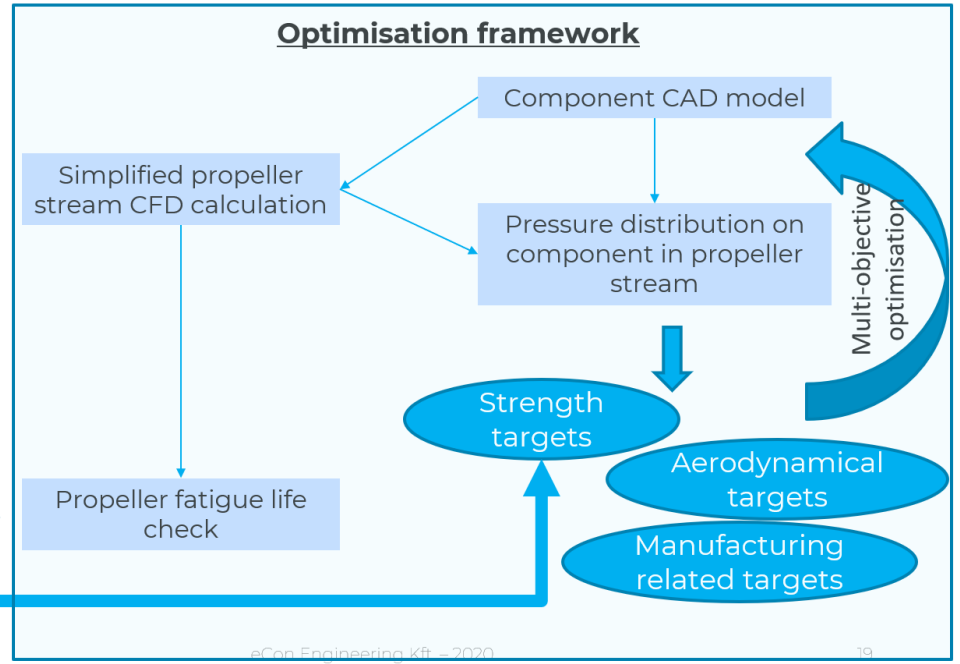


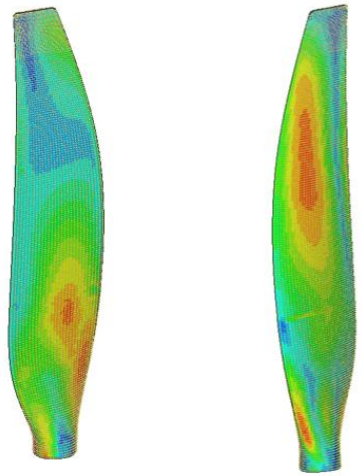


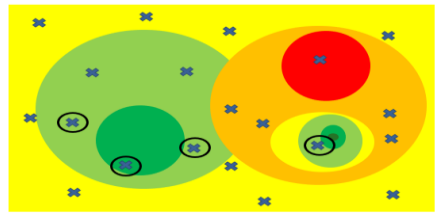
Applying AI in engineering applications

- Hungarian government funded domestic R&D project
- Exploiting AI in propeller optimisation from cfd and strength POV
- Two main subprojects
  - CFD project aims developing 2D to 3D blade correction for 2D based virtual blade modelling
  - FEM projects aims developing intelligent composite material parameter fitting methods including static and cyclic strength
- Side project: development of a virtual (numerical) predictive model for the fatigue behaviour of TP matrix based continuous fibre reinforced composites
- All models integrated in an optimisation workflow

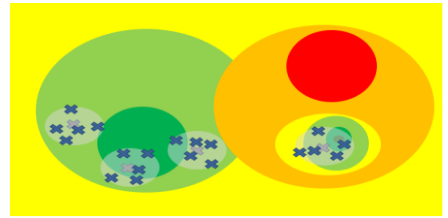








Generation 0



Generation 1

THANK YOU FOR YOUR ATTENTION!

eCon Engineering Kft.
H-1116 Budapest, Hungary
Floor 4, 3 Kondorosi Str.
Phone: +36-1-279-0320
www.econengineering.com