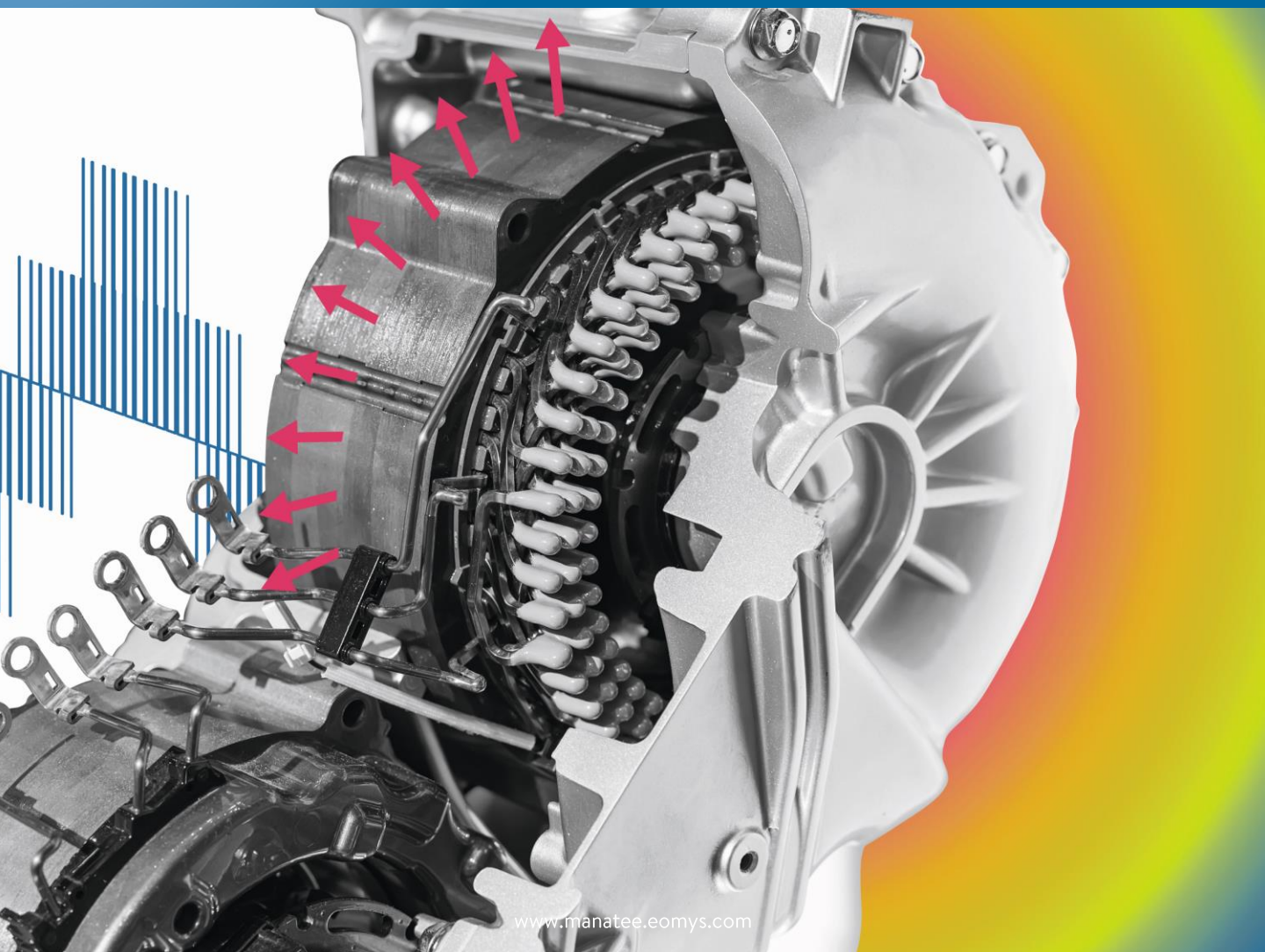
manatee by EOMYS

joins

SIMULIA

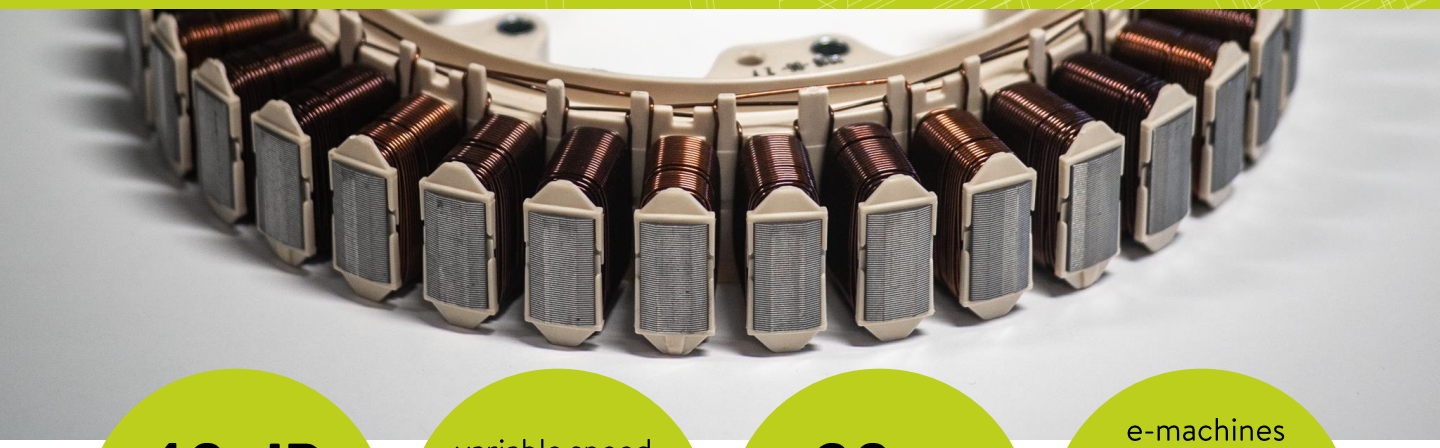
Manatee CAE collaborative platform

Improving e-NVH performances of electrical systems throughout their development lifecycle



www.manatee.eomys.com

Why using Manatee® software ?



40 dB
reduction after redesign

variable speed computing time
< 1 mn

> 20 yrs
cumulated R&D development on e-NVH

e-machines simulated with Manatee®
> 300

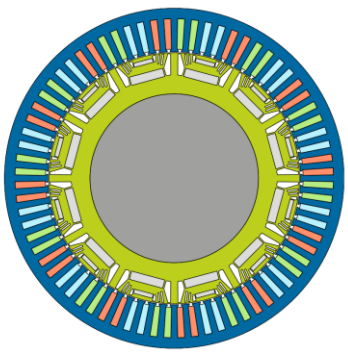
Manatee® offers a **collaborative simulation and analysis environment** designed to **quickly and accurately optimize vibro-acoustic performances of electrical systems under electromagnetic excitations.** Its user-friendly interface has been developed for electrical, mechanical, acoustic and NVH test engineers.

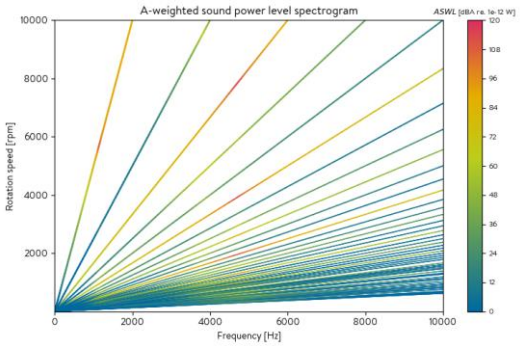
Designing high quality electrical systems requires to control their acoustic noise and vibration levels at every development stage, from risk analysis in preliminary studies to vibro-acoustic troubleshooting after prototype manufacturing. Electrical machines can induce significant **electromagnetic noise and vibrations** (e-NVH) due to Maxwell force excitations, resulting in sound levels going up to 125 dBA at 1 m. **Noise impacts health, comfort, environmental friendliness, mechanical fatigue and concerns all topologies and applications.**

Electrical, magnetic and mechanical early design choices can have up to ±20 dB impact on magnetic noise and vibration levels. However, prototyping and testing electrical systems is expensive and time-consuming.

Using Manatee® virtual prototyping environment results in **increased design productivity** and physical insights, **optimized electromagnetic and vibro-acoustic performances**, and shorter development cycles.

From e-machine geometry & control parameters...





... to system-level electromagnetic noise and vibration

www.3ds.com/products/simulia/manatee

What makes Manatee® unique?

Manatee® is the only software specialized in the calculation and analysis of electromagnetic noise and vibrations induced by electrical machines, including root cause analysis and noise mitigation tools.

Manatee® development started in 2013 at EOMYS Engineering, a company specialized in solving noise and vibration issues in electrical machines, because no other tool on the market could provide an efficient, accurate and in-depth analysis of electrical systems e-NVH behaviour.

Manatee® models and algorithms have been successfully applied to more than 200 consulting projects in a wide range of application: 1 cm to 10 m diameter, 10 RPM to 150 kRPM, internal & external rotor, axial & radial flux machines.

Fast

Set-up your multiphysics simulation with a button click using predefined workflows.

Get calculation results within minutes using specific e-NVH models and algorithms.

Accurate

Use state-of-the-art calculations methods adapted to each design stage.

Include faults and tolerances for robust e-NVH ranking of electric machines.

Insightful

Understand the root cause of noise with advanced visualization tools.

Run “what if” scenarios, parameter sweeps and easily compare simulation results.

Collaborative

Explore the most relevant noise mitigation techniques on your electrical system.

Work in parallel with other engineering departments through a user-friendly GUI.

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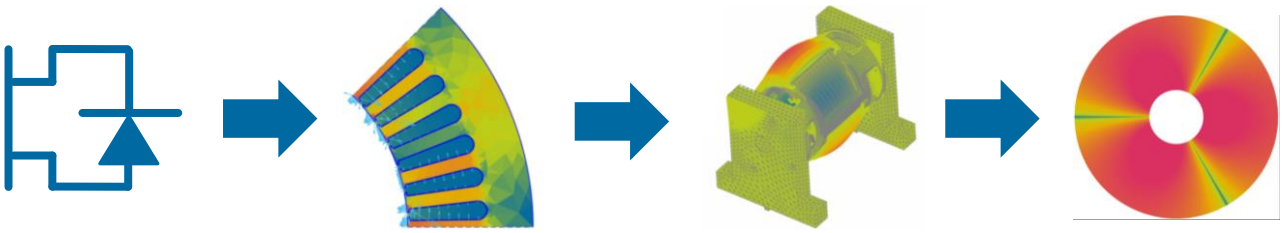
Feature insights



ELECTRICAL CIRCUIT | ELECTROMAGNETICS | STRUCTURAL MECHANICS | ACOUSTICS

Use **predefined simulation** templates adapted to every design stage and engineering field

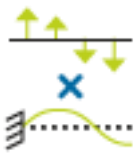
Include fault & mechanical tolerances for a **robust vibro-acoustic design**

Find the **root cause** of noise and vibration in terms of structural modes and excitation forces

Choose and optimize the most adapted magnetic, control or mechanical **noise mitigation technique**

Run **offline Campbell diagrams** of magnetic forces to compare different e-machines

Run e-NVH calculations on whole **torque speed plane** to capture partial load resonances



Import a modal basis and analyse its response to **unit-wave Maxwell excitations** without running magnetic calculations

Combine structural calculations with operational loads using **electromagnetic vibration synthesis**

Separate the contribution of different magnetic orders with the automatic **order tracking** analysis

Analyze variable speed e-NVH effects with **spectrograms** and **listen** to your e-machine sound

Run **parameter sweeps** on electrical machine design parameters

Compare different simulation results and find the best electromagnetic and vibro-acoustic trade-offs

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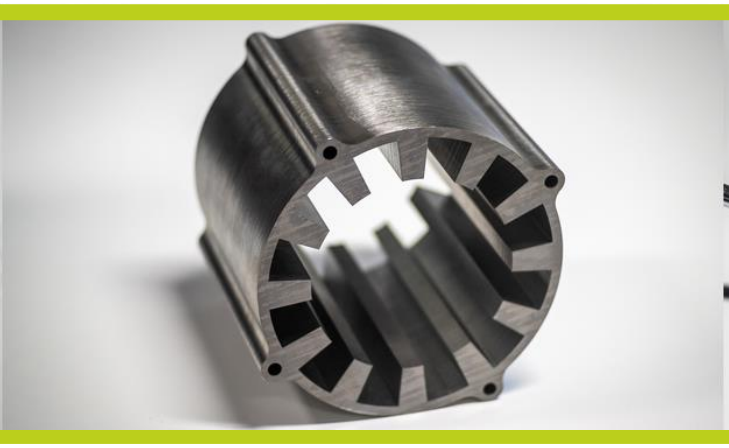
Manatee® licensing and e-NVH support

Trial License	Single Computer License	Floating License	Batch-Mode License
✓ Single Computer	✓ Single Computer	✓ Single Computer	✓ Single Computer
✗ Multi Computers	✗ Multi Computers	✓ Multi Computers	✗ Multi Computers
✗ Offline Server	✗ Offline Server	✓ Offline Server	✗ Offline Server
✗ Leasing	✓ Leasing	✓ Leasing	✓ Leasing
✓ GUI	✓ GUI	✓ GUI	✗ GUI



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Application examples

Automotive

Problem: during the electromagnetic design of an IPMSM traction motor for electric powertrain, electrical engineers want to study the NVH impact of the skew pattern. This calculation is taking days in a general purpose FEA software.

Solution: with Manatee®, the effect of the rotor skew pattern on average torque, torque ripple and magnetic noise is quickly calculated on whole torque speed plane, providing clear guidance to **electromagnetic engineers**.

Industry

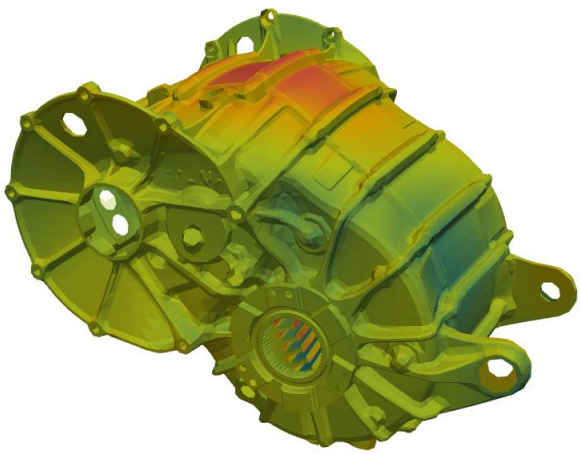
Problem: the prototype of an industrial pump is rejected by the end customer because it sounded louder than its competitor. The motor pump designer wants to improve its sound signature.

Solution: Manatee® helps to analyze test data, confirm the magnetic origin of the noise issue, and set clear noise reduction targets using sound synthesis feature. The effect of moving a natural frequency is then studied by **acoustic engineers** to meet the new targets.

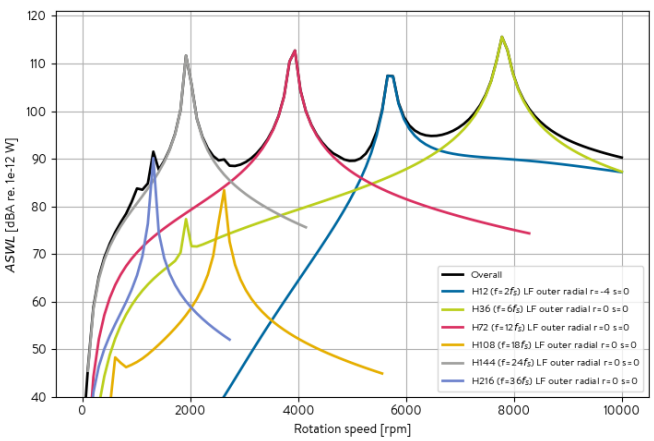
Energy

Problem: a tonal noise issue is identified during factory acceptance tests of a wind turbine generator. Design engineers want to understand what is causing this sound and to reduce it.

Solution: Manatee® simulation allows to identify the modes and magnetic forces responsible for high tonality. A simulation is then run by **control engineers** to confirm the efficiency of harmonic current injection technique.



Operating Deflection Shape computed in Manatee®



A-weighted Sound Power Level Order Tracking analysis obtained with Manatee®

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Application examples

Consumer goods

Problem: a new manufacturing process of a BLDC motor fan results in a higher eccentricity and uneven airgap. This may degrade sound quality and engineers would like to estimate this without running NVH tests.

Solution: Manatee® simulation is set-up and run to quickly estimate the impact of asymmetries on acoustic noise due to electromagnetic excitations. This allows **mechanical engineers** to specify mechanical tolerances in line with NVH requirement.

Naval

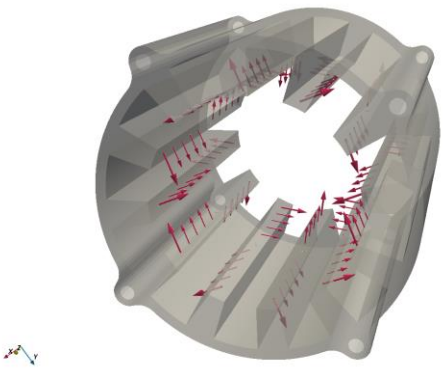
Problem: a new electric propulsion unit is designed to comply with Silent Class ship. Induction motor structure-borne noise must be evaluated but magnetic force calculation requires time consuming transient FEA simulation by **electrical engineers.**

Solution: Manatee® quick permeance / mmf model is used to calculate magnetic forces. Resulting structure-borne noise is obtained with vibration synthesis algorithm. Compliancy with standards is easily checked with third octave analysis.

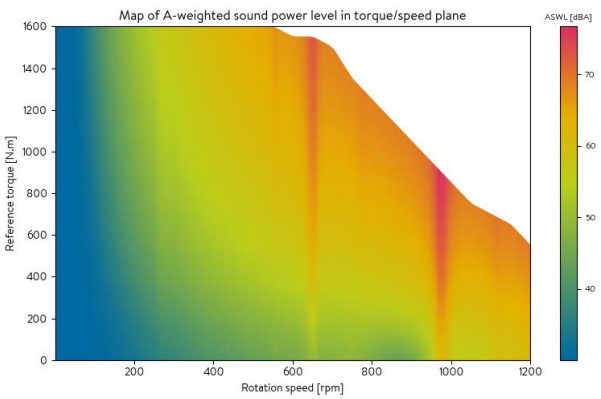
Railway

Problem: An initial electrical design of a squirrel-cage induction motor is carried for a light rail vehicle application. Sound power level has to fulfil IEC 60034 noise limits at variable speed, which requires a huge number of multiphysic calculations.

Solution: electrical and mechanical engineers quickly perform e-NVH calculations under Manatee®, showing the presence of a large slotting resonance. A parameter sweep is on rotor slot number, achieving 15 dB noise reduction with same torque level.



Magnetic tooth forces computed in Manatee®



A-weighted Sound Power Level on full torque/speed plane calculated with Manatee®

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About EOMYS

With more than 100 customers worldwide, EOMYS Engineering has developed a unique, world-renowned, **multi-disciplinary expertise of electrical systems vibro-acoustics.** Based in Lille, North of France, EOMYS provides software development and engineering consultancy services. Our team includes electrical, mechanical, NVH test engineers as well as R&D software engineers.

Consultancy services

EOMYS provides engineering **consultancy services** including e-NVH measurements, modelling and simulation. See www.e-nvh.eomys.com for further information.

Technical trainings

Interested in following a **technical training** on magnetic noise and vibrations? Check our website www.training.eomys.com to register to our next e-NVH training session.