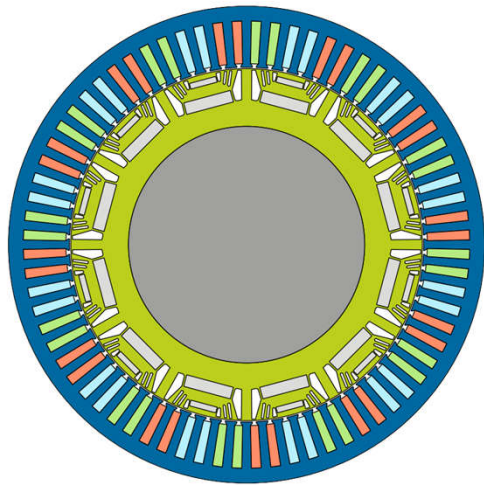




Manatee[®] e-NVH software key benefits

*From e-machine geometry
& control parameters...*



*... to system-level electromagnetic
noise and vibrations*

Special technical problems require special technical solutions...

Manatee is the only software specialized in the assessment and control of electromagnetic noise and vibrations due to Maxwell forces (“e-NVH”) induced by electric machine operation, from e-motor basic design stage to system-level detailed design stage. This results in a fast, accurate, insightful and collaborative environment:

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

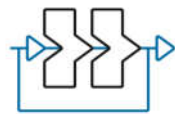
Explore both mechanical and electrical noise control techniques.

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



To make engineering work far more efficient...

EOMYS electrical, mechanical and NVH test engineers have been involved in the development of >150 electrical systems. Based on this extensive experience of magnetic noise issues troubleshooting and solving, the following features have been developed in Manatee software:



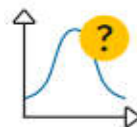
Predefined simulation workflows from basic to detailed design phases



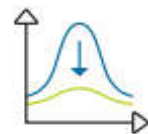
Fast and accurate calculations adapted to each engineering field



Robust design including manufacturing tolerances



Root cause analysis using powerful post-processing



Mitigation techniques with specialized design environments



Besides general purpose CAE software suites.

More than 100 customers worldwide have ordered Manatee-based e-NVH consulting service – and they all had access to Ansys Workbench, Siemens Simcenter or other multiphysic FEA software... General purpose FEA suites suffer from complex e-NVH workflow set-up, long simulation times, tedious post-processing and result interpretation...

		Ansys / MotorCAD	Romax	Altair	Siemens	Comsol
e-NVH simulation templates adapted to each design phase	✓	✗	✗	✗	✗	✗
e-NVH root cause analysis tools giving load case & mode contributions	✓	✗	✗	✗	✗	✗
e-NVH mitigation tools combining mechanical & magnetic techniques	✓	✗	✗	✗	✗	✗
Leasing support by e-NVH engineers	✓	✗	✗	✗	✗	✗
Vibration synthesis algorithm, allowing mechanical & electrical eng. parallel work	✓	✗	✗	✗	✗	✗
Torque / speed plane e-NVH calculations	✓	✗	✗	✗	✗	✗
Advanced multiphysic visualization in time/frequency domains	✓	✗	?	✗	✗	✗
Quick e-NVH models for early design of PMSM and induction machines	✓	✗	✗	?**	✗*	✗
Integrated, user-friendly GUI for simulation set-up, run & post processing	✓	✗	✓	✗	✗	✗
Fast magnetic load calculations to capture accurately variable speed resonances	✓	✗	✗	✗	✗	✗

*Siemens announced development of permeance/mmfm models but they are not available in standard software

**Altair Flux proposes fast e-NVH evaluation of PM machines, but not induction machines under load

Manatee software benefits from a wide user experience...

- Manatee was used by EOMYS engineers to analyze more than 150 electric motor noise issues
- Manatee models were successfully applied on wide range of topologies:
 - inner and outer rotor, axial and radial flux
 - 5 rpm to 150 krpm
 - 1 cm to 10 m airgap diameter
 - 100 W to 40 MW
 - SRM, BLDC, IPMSM, SPMSM, DFIM, SCIM, SynRM, WRSM
- Manatee was used on wide range of markets including EV/HEV NVH applications



PORSCHE



Vestas ebmpapst



Providing key benefits at project management level.

- **Reduced development costs:** reduce the number of manufactured prototypes as well as test & validation costs
- **Reduced development times:** make your engineering team work more efficiently with faster simulation & analysis tools
- **Better risk management:** control of e-NVH risks all along the V-model development cycle, from e-motor basic design to system validation
- **Increased know-how:** improve the collaboration and multiphysic learning curve of your engineering department within an insightful user-friendly GUI
- **More business:** broaden your system applications with a better control of the e-NVH signature of your product



Conclusion

- Manatee provides **high productivity gains** as it is >1000 faster than general purpose FEA software:
 - > 10x faster for simulation set-up
 - > 10x faster for e-NVH calculations
 - > 10x for post processing and application of noise reduction techniques
- Manatee is the **most advanced solution** to tackle electromagnetic noise problems **throughout development lifecycle**

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