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Licensing and modules

- Products - MANATEE -

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Leasing options

EOMYS proposes 6-month or 12-month leasing options of MANATEE software specialized in the vibro-acoustic and electromagnetic design of electrical machines (e-NVH due to Maxwell forces). Leasing option allows to acces to all MANATEE modules.

Contrary to a standard software maintenance, the 6-month (resp. 12-month) leasing option includes a **8- hour (resp. 16-hour) package of consulting hours which can either be used for advice on NVH design of e-motors** (more than just IT support) or **customized software development** (for instance, implementation of a new post processing).

Based on our past experience of MANATEE support, our customers regularly ask some questions on noise due to electromagnetic excitations or some advices on best noise mitigation techniques to be investigated in their particular application, which are not directly related to IT support. **With this leasing mode, EOMYS can more freely discuss and share its expertise of electromagnetic noise issues**.

Demonstration option

As the electrical machine topologies of the trial version are frozen, if you want to have a better idea of MANATEE performance on your specific application, a **refundable consulting workpackage to simulate and interpret the electromagnetic and vibro-acoustic behavior of your specific machine** using MANATEE is proposed. The cost of this consulting work is deduced from the software license cost in case of MANATEE purchase. This way, EOMYS show you how to use MANATEE and the most relevant NVH post-processing on your application to troubleshoot NVH issues. The full consulting workpackage includes the following:

- implementation of your machine geometry in MANATEE
- set-up of the simulation project
- variable speed electromagnetic and vibro-acoustic simulation in no-load sinusoidal case (IM) or open-circuit case (SM)
- analysis of main magnetic force harmonics and potential issues including load effect
- delivery of a technical presentation with main simulation results (Powerpoint)
- 1h conference call to present & discuss results and show you how the simulation has been defined and run in MANATEE
- **delivery of the simulation and machine data files defined by EOMYS if a MANATEE perpetual license is purchased, or a 2-year leasing**

Perpetual licensing options

EOMYS delivers **perpetual commercial licenses** of MANATEE software on a USB dongle key with node-lock, multiple access and clustering options.

The first year subscription to EOMYS ENGINEERING maintenance service is included in the licenses of new products. A **yearly fixed-rate maintenance** allows to benefit from technical support and license updates - new

features and validations are regularly carried by EOMYS engineers based on customer feedback as shown in our newsletters. Contrary to the leasing option, the perpetual license allows to choose some specific modules:

MANATEE software module description

Research license options

Free **fixed-term research licenses** can be released depending on the scope of the research project. EOMYS is more particularly interested by research project involving experimental measurements, and software solution benchmarking. For a research license request, you can contact us through the contact form.

MANATEE software module list

Module Name	Function	Description
ENVH	E-NVH simulation workflow and post processing at single speed	MANATEE basic simulation workflow and post processings for the vibroacoustic calculation of electrical machines at a single speed. For MANATEE built-in fast electromagnetic models, electrical machines must be defined using available geometrical overlays. Contains more than 120 command line plots (permeance, flux, force, vibration and noise) including FFT in 1D or 2D spaces, and all vibro-acoustic post processing at single speed (A-weighting, sound power and pressure spectrum and overall levels, modal participation factors, operational deflection shapes, sound synthesis)
ALG.SSA	Spectrogram Synthesis Algorithm to speed up variable speed calculation of operational magnetic loads	Fast variable speed NVH calculation based on accurate magnetic force extrapolation algorithms at variable speed (neglecting the change of saturation at variable speed, to include that LAB.VS is needed) or airgap flux look-up tables calculated with ALG.FLT. The waterfall synthesis accounts for specified control law (e.g. Id/Iq function of speed). All post processing of ENVH are extended to variable speed (noise and vibration waterfalls, order tracking analysis, modal participation factors).
ALG.FLUT	Airgap flux density Look Up Tables to speed up NVH calculation where saturation vibro-acoustic effect cannot be neglected	Calculation of air-gap flux density look up table at different excitation (Id,Iq) for PMSM. Most relevant when coupling MANATEE with FEMM using EM3.SM. The flux density look up table allows to quickly calculate magnetic forces and torque ripple including saturation effects, which can be reused in SOL.SKEW for skew optimization or ALG.SSA for spectrogram synthesis or LAB.VS for variable speed NVH calculations. MANATEE built-in projection algorithm allows to reliably convert airgap Maxwell stress to stator tooth magnetic forces.
ALG.EVS	Electromagnetic Vibration Synthesis to speed up variable-speed FEA-based NVH calculations, or optimization of electromagnetic excitations	Speed up magnetic vibration calculations while giving more physical insights by applying elementary harmonic loads on the structural model to calculate Frequency Response Function of the structure (rotor or stator). Can be used with any type of structural model provided in SM (analytic or FEA such as Gmsh/GetDP, Hypermesh/Optistruct, Ansys). Useful when a high number of operational loads have to be calculated, for instance in variable speed calculations (e.g. NVH maps on torque speed plane) or in optimization mode (e.g. pole shaping). Does not handle skewing in v1.07.

LAB.VS	Quasi Static Variable Speed	Calls several MANATEE fixed-speed steady state simulations with varying input parameters depending on the control strategy (e.g. constant flux, torque/speed curve, etc). All NVH post processing of ENVH module are extended to variable speed (overall SPL/SWL as a function of speed, noise and vibration waterfalls, order tracking analysis, variable speed modal participation factors, force / vibration / noise spatiograms, operational deflection shape).
LAB.TR	Transient Variable Speed	Calls MANATEE models in full transient mode (non-linear increase of rotor rotating speed). Currents and rotor angle are specified as time waveforms so that non uniform run-ups can be simulated. All variable speed post processing of LAB.VS are then available.
LAB.MAPS	Acoustic noise calculation over full torque / speed range (noise maps)	Calls several MANATEE simulations based on input Id/Iq maps to characterize the e-motor NVH behaviour in torque/speed plane on four quadrants (traction / braking / reverse modes), including noise map plots and detailed post processings.
SOL.HARM	Harmonic Analysis for e-NVH troubleshooting	Provides NVH root cause analysis tools to cancel any magnetic force harmonic by stage (permeance, magnetomotive force, radial/tangential flux, radial/tangential force) or by physical origin (rotor/stator mmf, PWM time harmonics, winding or magnetization space harmonics) manually or automatically to analyze the root cause of magnetic noise and vibrations. Provides command line tools to analyze the origin of a given force wave in terms of permeance/mmf wave combination for different topologies and load state.
SOL.FSIM	Mechanical and Electromagnetic Fault Simulation	Handles manufacturing tolerances and fault simulation such as static and dynamic eccentricities, uneven airgap, PMSM demagnetization, SPMSM pole displacement, stator short circuit, SCIM broken bar to study the NVH effect of asymmetries both at design stage (to specify tolerances) or after manufacturing (to troubleshoot noise issues).
SOL.NOTCH	Stator and rotor notching	Allows to include notches (dummy slots) on both stator and rotor laminations with different shapes (polar, rectangular) and spacing to damp some specific electromagnetic force harmonics.
SOL.SKEW	Skew pattern optimization	Design environment to study the impact of skew pattern on acoustic noise and vibrations, average torque and torque ripple using flux distribution look-up tables. The vibroacoustic model can be of any type depending on MANATEE inputs (semi-analytic, numerical, or with imported FRF). A sensitivity study on a linear continuous or stepped skew angle can be run to find the best tradeoffs between noise & torque ripple minization. Alternatively a full multiobjective optimization can be run on the stepped-skew pattern.
SOL.CINJ	Harmonic current injection module	Allows to inject id or iq harmonic currents in DQH or ABC frame to study their impact on NVH.
IO.ELEC	Import of external current/voltage waveforms	Imports a user-defined voltage or current waveform to be used in quasi static (resp. transient) variable speed analysis, without (resp. with) rotor angle waveform. The rotor position is adjusted to achieve user-defined operating point in steady state. The imported waveform is filtered according to user-defined parameters. The NVH effect of unbalance current or parasitic harmonics coming from experimental or third party simulation models can be studied.
IO.FLUX	Import of external magnetic field distribution	Imports the airgap flux density distribution calculated with third party electromagnetic software at single speed or variable speed, and projects the airgap Maxwell stress on the inner and outer structures to calculate magnetic forces and resulting NVH behaviour. Includes harmonic filters to remove parasitic harmonics coming from remeshing issues.
IO.FMAG	Import of FEMAG model	Imports FEMAG electromagnetic software output files (e.g. PLT0 and BCH) to run MANATEE vibration and acoustic calculations without having to redefine completely the electrical machine in MANATEE, including all NVH post processings at variable speed. Cannot import FEMAG model generated with .dxf.

IO.MF	Export of magnetic forces	Exports calculated harmonic magnetic forces per tooth tip (lumped load vector) or per node in .unv format (e.g. for use in LMS)
IO.WAV	Export of calculated noise as .wav file	Exports calculated sound pressure level as a .wav file in steady (sine supply, PWM) or quasi static variable speed mode (sine supply) for further analysis in third party sound quality software and calculation of psychoacoustic metrics
EL.SCIM	Electrical model for inner rotor squirrel cage induction machines	Calculates the harmonic stator and rotor currents based on input phase voltage waveform by calculating the equivalent circuit parameters, including skin effect and saturation effects. Some parameters (leakage and magnetizing inductance) can be evaluated with finite element (coupling with FEMM) if the module EM3 is activated. Possibility to enforce user-defined lumped parameters.
EL.DFIM	Electrical model for inner rotor doubly fed induction machines	Calculates the stator and rotor currents based on input phase voltage waveform by calculating the equivalent circuit parameters, including skin effect and saturation effects. Some parameters (leakage and magnetizing inductance) can be evaluated with finite element (coupling with FEMM) if the module EM3 is activated. Possibility to enforce user-defined lumped parameters.
EL.PMSM	Electrical model for surface, surface inset and interior permanent synchronous machines	Calculates the stator currents based on input phase voltage waveform by calculating the equivalent circuit parameters (inductances Ld, Lq, PM flux linkage E), including skin effect. Some parameters (leakage and magnetizing inductances) can be evaluated with finite element (coupling with FEMM) if the module EM3 is activated. Possibility to enforce user-defined lumped parameters.
CT1.SCIM	Control module for squirrel cage induction machines	Calculates the slip and voltage to achieve specified torque characteristics based on the equivalent circuit parameters.
CT1.DFIM	Control module for doubly fed induction machines	Calculates the slip and voltage to achieve specified torque characteristics based on the equivalent circuit parameters.
CT1.SM	Control module for synchronous machines	Calculate the current angle to achieve specified torque based on the equivalent circuit parameters according to MTPA strategy.
CT2.PWM	PWM module.	Generates 3-phase or 6-phase PWM voltage waveforms, analytically, numerically (symmetrical intersective PWM, equivalent to SVPWM) or based on a Simulink model (built-in MANATEE Simulink model or user-defined Simulink model). Available commutation strategies: asynchronous switching, synchronous switching, calculated angles. Possibility to randomize the carrier frequency in the built-in MANATEE Simulink model (RPWM). The resulting voltage waveform must be input to an electrical equivalent circuit model to obtain resulting current waveform.
EM1.PMMF	Electromagnetic analytical module based on permeance / mmf and winding functions for IPMSM, SCIM, WRSM, PMSM, DFIM	Calculates the airgap rotor and stator radial flux density time and space distribution based on permeance / mmf model. Includes rotor and stator skewing (any skew shape), any winding type. Hybridation with FEMM to calculate rotor mmf of IPMSM. Possibility to account for saturation with saturated permeance wave.
EM2.SCIM	Electromagnetic semi-analytical module for inner rotor squirrel cage induction machine	Calculates the airgap rotor and stator radial and tangential flux density time and space distribution based on subdomain models. Includes armature field with any winding type and skewing effect. Assumes semi opened slots with polar geometry and infinite permeability of magnetic materials.

EM2.SPMSM	Electromagnetic semi-analytical module for surface or surface inset permanent magnet synchronous machines	Calculates the airgap rotor and stator radial and tangential flux density time and space distribution based on subdomain models. Includes armature field with any winding type and skewing effect. Assumes semi opened slots with polar geometry for stator, but any shape of surface magnet, and infinite permeability of magnetic materials.
EM2.IPMSM	Electromagnetic semi-analytical module for inner rotor interior permanent magnet synchronous machines	Calculates the airgap rotor and stator radial and tangential flux density time and space distribution based on subdomain models. Includes armature field with any winding type and skewing effect. Assumes polar geometries with semi opened slots on stator, and magnet pocket shape according to provided overlays, and infinite permability of the stator (IPMSM saturation is included using a coupling with FEMM to calculate the equivalent rotor magnetization, but rotor saturation is not affected by armature field).
EM3.SM	Electromagnetic finite element module for surface, inset or interior permanent magnet synchronous machines or wound rotor synchronous machines	Couples MANATEE with open-source electromagnetic software FEMM for non linear or linear magnetostatics problem (automatic drawing, meshing and post processings). Calculates the airgap radial and tangential flux density time and space distribution, as well as torque, and flux linkages. Includes skewing and any winding type, inner and outer rotor. Can be used to calculate the flux density look up tables of ALG.FLUT.
EM3.IM	EElectromagnetic finite element module for inner rotor squirrel cage induction machines at no-load or doubly fed induction machines at partial load	Couples MANATEE with open-source electromagnetic software FEMM for non linear or linear magnetostatics problem (automatic drawing, meshing and post processings). Calculates the airgap radial and tangential flux density time and space distribution, as well as torque, and flux linkages. Includes skewing and any winding type, inner rotor.
MF.VWP	Electromagnetic force calculation using Virtual Work Principle	"Calculates the electromagnetic nodal Maxwell forces on a 2D FEMM mesh using Virtual Work Principle method. Cannot be used yet with SM models.
SM.ANL	Structural Mechanics semi-analytical module	Calculates the natural frequencies of the outer structure (rotor or stator) based on an equivalent cylinder including longitudinal modes and boundary conditions. Calculates dynamic radial deflections of the outer structure under magnetic forces with an equivalent 2D ring model. Possibility to enforce modal parameters.
SM.NUM	Structural Mechanics finite element module for modal analysis and FRF	Automatically couples MANATEE with finite element mechanical software (open source GetDP, commercial Altair Optistruct or Ansys Mechanical) to calculate the mode shapes of the outer structure as well as Frequency Response Functions (FRF) under different magnetic force patterns. Calculates the resulting dynamic deflection of the outer structure based on Electromagnetic Vibration Synthesis algorithm. Possibility to generate automatically a "concept stator/rotor" (3D external stator structure including winding or external rotor including magnet weight) or to run the analysis on an existing Optistruct/Ansys model.
AC.ANL	Acoustics semi-analytical module	Calculates the radiation factor of the external structure based on semi analytic models of cylindrical shells and vibration velocity field obtained from structural model SM. Calculates analytically the sound power level and sound pressure level radiated by the machine based on micro position and room constant.
OP.SA	Sensitivity Analysis and parameter sweep	Couples MANATEE with a global optimization tool (NSGA-II) for constrained multiobjective mixed variable optimization, or with local optimizer (SQP) for local single objective optimization.
OP.CMO	Constrained Multiobjective Optimization	Calculates the sensitivity of a response variable with respect to design variables (e.g. to study the effet of +/- 5% pole width or slot numbers on noise) and quantify the correlation factors, using different sampling strategy of the design space to be explored.

OP.MDE	Multidimensional Design Explorer	Multidimensional optimization or sensitivity results can be visualized conveniently with the Mult Sim Viewer Graphical interface under Matlab, combining 5D visualization of Pareto fronts or sensitivity studies (3 axis + color + shape). Filters can be applied on design variables, response variables or constraints and designs can be marked along the different projection windows to ease multidimensional design space exploration.