Detroit Engineered Products (DEP), is an engineering services, product development, software development, consulting, and talent acquisition company. Since its inception in 1998 in Troy, USA, DEP is now a global company with footprints in Europe, China, Korea, Japan, and India. DEP uses the accelerated and transformed product development process, accomplished by utilizing our proprietary platform, DEP MeshWorks, which rapidly reduces the development time of products for all segments. The MeshWorks platform delivers tool sets that accelerate virtual validation activities associated with powertrain development across all stages for both conventional and electric powertrains.

With increasing innovation and environmental awareness, EVs have never been more exciting to drive. The electric drivetrain/motor system of EVs presents a gamut of engineering challenges that require specialized domain expertise. DEP's highly experienced design & and engineering team provides solutions aimed at developing motors that are more efficient and optimized to provide sufficient power and torque density levels, making them durable for mass production, across mobility platforms. We provide our customers with services covering motor design and development, optimization techniques, and redesigning strategies. Our customized powertrain solutions offer high efficiency, accelerated performance, and better durability.

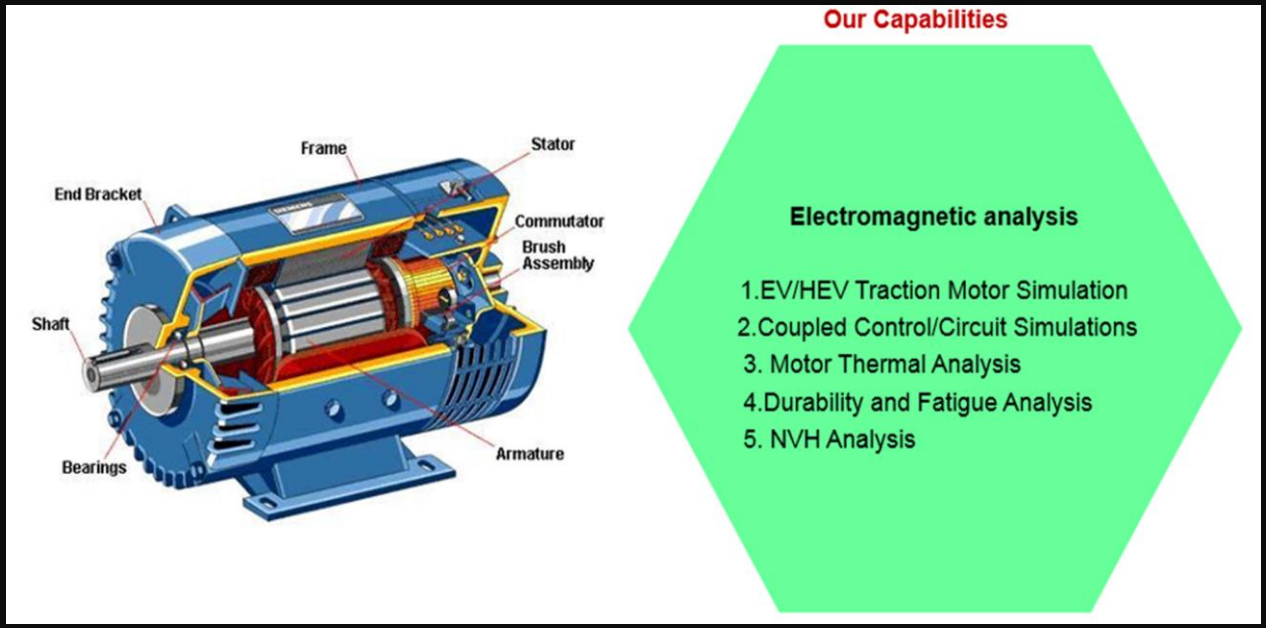
DEP offers a complete motors design & and development suite, from concept design to detailed electromagnetics, and thermal and mechanical analyses of the motor. We offer comprehensive engineering solutions focused on value-added results that encompass coupled control/circuit, noise & and vibration, and durability & and fatigue simulation for the motor system using expert tools & and techniques. Over the decades, DEP has earned a strong reputation as a trusted partner by delivering accurate and robust design engineering services that optimize the powertrain for performance, cost, and efficiency.

DEP

Smarter solutions. Realized.

ELECTRIC MOTOR SOLUTIONS

- Motor represents a major cost, and most automotive OEMs invested heavily in developing their own motor hardware. But EV becoming the future of transportation, a change of course is required in the designing process which starts all the way from scratch for developing the motor/generator.
- The EV/HEV initiatives are facing lots of design challenges because of increasing dependency on electrical components and overall complexity, coupled with short design cycles.
- Capability of DEP includes, calculating the induced voltage, load torque, cogging torque, inductance, flux linkage, losses (iron, copper, and magnet), parameter sensitivity, equivalent circuit model extraction, heat generation, temperature distribution, stress, vibrations, radiated sound, magnetization, demagnetization, and skew effects.

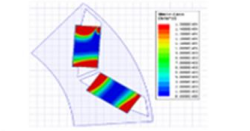


EV/HEV Traction Motor Simulation

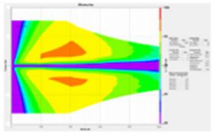
- DEP's traction motor simulation is a perfect solution for today's automotive engineers whose optimization needs include efficiency, size & cost along with NVH, Reliability & Durability.
- DEP's accumulated knowledge and experience in motor design, the various mechanical, fluid dynamics, thermal, electrical and electromagnetic related secgments suites various complex requirements.

Coupled Control/Circuit Simulations

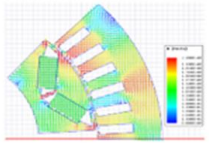
- Building hardware is a great art that requires time and lot of procedures & guidelines. But evaluating the machine model by connecting them to circuit model is the new extraordinary experience that DEP can provide.
- The analyses are performed by linking to power electronic simulators such as Simplorer and MATLAB/Simulink. The coupled simulation technique is developed based on the finite element method. The circuit simulation is mainly devised for improving design capability and efficiency.



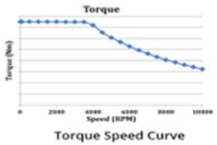
Magnet eddy current loss density



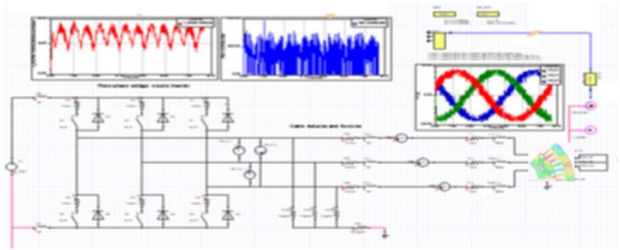
Efficiency map



Flux density vector plot



Torque Speed Curve

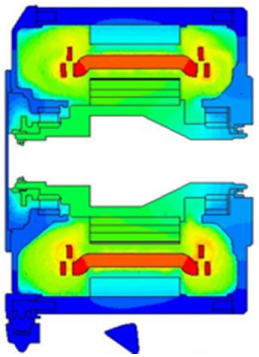


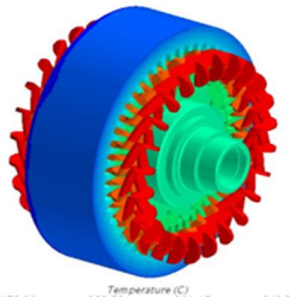
FEA+Circuit (co) simulation

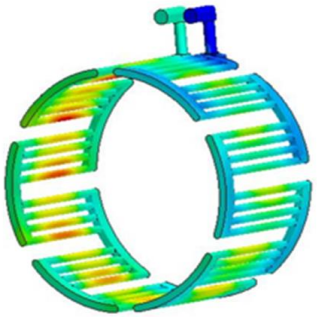
Motor Thermal Analysis

- Temperature is an important factor that affects the performance of electric machines. In order to develop smaller and more efficient electric motors, there is a need to carry out more thermal analysis in parallel with the traditional electromagnetic design.
- By employing computational fluid dynamics (CFD) while doing motor design, one can accelerate the development, achieve better motor cooling and also higher efficiencies. Conjugate heat transfer (CHT) analysis on motor will help in understanding the heat loss to components, coolant and atmosphere. Optimized flow path can be designed based on the CFD results, which helps in improving life of the motor.
- Motor thermal analysis are done as follows:
  - 3D Induction motors analysis for mild hybrids
  - 3D PM motor for full hybrid/ EV's
  - 1D AMESIM / GT Suit model for system simulation

Temperature Plot





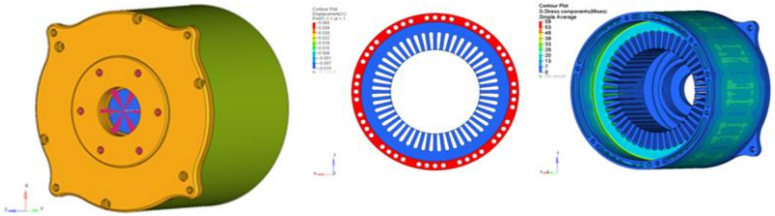


Durability and Fatigue Analysis

- Fatigue and durability analysis is the test of time for structural parts that operates over and over, day after day. Mainly this analysis aims to explain how mechanical material behavior relates to the design of structural machine components.

- Fatigue and durability analysis involves time, because failures are progressive in nature and mostly depends on local stress scenario since it is prone to localization also it various based on the impact of working or fluctuating loads . Loads refer to any physical quantity that reflects the excitation or the behavior of components that form a system over time. The most typical loads are forces, torques, stresses, strains, displacements, velocities and accelerations. Other sort of loads may be pressure or flow in hydraulic devices, rotational speed, temperature, or even state variable values in electronic control unit. Computer simulations determine how well the particular part will hold up during cyclic loading in stipulated time without much effort & energy. These calculations incorporate all data regarding materials, environmental conditions and specified constraints too.

- DEP's capabilities for lifetime assessments ranges from basic tools with simplified load assumptions to advanced applications that targets specialized engineering-analysis tasks. The basic fatigue and durability analysis done by DEP can provide an elaborate stress analysis to avoid under- or over-designing of products by simulating actual loading conditions and it helps in comparing designs or design options. Eventually the test result states the service life until damage is sustained.



Email us: email@depusa.com | Visit our Website: www.depusa.com
USA: MI (HQ) : Detroit Engineered Products, 850 East Long Lake Road, Troy, MI 48085, USA. I Phone: +1-248-269 7130
INDIA : DEP India Pvt. Ltd., #2/86, 7th Avenue, Ashok Nagar, Chennai – 600 083, India I Phone: +91 44 42141453
BANGALORE : DEP India Pvt. Ltd., 4th Floor, Gamma Block, Sigma Soft Tech Park , HAL – Whitefield Main Rd , Bangalore 560066