Q: Is MagNet directly coupled with FloEFD and then directly coupled with Heeds? Or it just uses the results previously calculated?
A: The EM heat losses were transferred manually to FLOEFD. MAGNET does not yet have a HEEDs portal, but FLOEFD does. However, due to the open-architecture of MAGNET and HEEDS, it can be scripted from HEEDs if necessary.

Q: Having made the initial design in Motorsolve, how does the geometry (including outer casing) transfer to Magnet and then FloEFD?
A: The only exportable geometric model from Motorsolve to MAGNET is an extruded 2D model without end-windings. The end-windings and the housing were added in MAGNET, or they can simply be imported. The 3D CAD model can then be transferred to FLOEFD into the corresponding CAD system and its interfaces.

Q: Can you use ThermNet results in FloEFD?
A: ThermNet results are mainly temperature fields; the same thing being solved for by FLOEFD, including the fluid-thermal dynamics that are approximated or not present in ThermNet.

Q: How have you modelled the contact resistance between the windings and the stator?
A: In Motorsolve, we use an FEA model that represents the windings as a component while taking into account the effects of strands and epoxy filling of the slot area as composite materials that modify the thermal conductivity. Motorsolve also has the provisions for defining the thickness of the slot-liners and the slot filling materials. So you do not have to physically compute your resistances.

Q: Also how have you modelled the air gap convective resistance?
A: We use a “convective gap link” to represent the heat transfer across the airgap. See the following link for more info: https://support.mentor.com/en/knowledge-base/MG601256

Q: Is there a possibility to couple the two tools, Magnet, and FloEFD, i.e. how can the changed cooling performance be taken into account in Magnet?
A: There is a possibility of using scripts.

Q: Could you share the total time taken to complete this simulation?
A: For coupled EM-thermal FEA analysis in Motorsolve it will just be a few minutes since it is 2D FEA based. In MAGNET, since we simulated the whole 3D model including the end-windings but excluding the housing and shaft, it took ~19 hrs for a transient 3D analysis, with 100 steps/samples.

For FLOEFD and HEEDs analysis it took about 1 day including a few breaks with some standard settings. That means possibly with some more user effort and modifications we can accelerate this. In addition, the laptop was being used for other applications, and sometimes the study was paused. It is therefore possible to make these type of studies overnight. The laptops used for all the analysis are 64 bit Intel Core i7 2.90 GHz, 4 cores, 32 GB Ram.
Q: You used pins for cooling, have you tried it practically?
A: Unfortunately I did not try in a real model. This is a generic example, but we are always happy to attend case studies on real examples.

Q: Is it possible to run the lifetime prediction analysis? Is it possible to enter the lifetime loading and get the analysis results according to this loading?
A: Please can you elaborate more on what you mean by lifetime loading, because we are not experts in this domain. However, if the lifetime is known in a form that can be synthesized as inputs for the analyses, then predictive analysis can be done.

The HEEDS workflow process can connect different software tools (even own tools): https://www.redcedartech.com/index.php/solutions/heeds-software/process-automation

Q: Is the iron hysteresis included in Magnet 3D calculation?
A: In 3D MagNet, Hysteresis, eddy-current and excess losses are post-processed via the modified two-term Steinmetz formula, while in 2D MagNet, the user can enable the in-solving calculation of Hysteresis losses only.

Q: When was hysteresis included in 3D solutions in Magnet? A few months ago it was included only in 2D solvers.
A: In 3D MagNet, Hysteresis, eddy-current and excess losses are post-processed via the modified two-term Steinmetz formula, while in 2D MagNet, the user can enable the in-solving calculation of Hysteresis losses only.

Q: After completing the CFD analysis, we might like to re-run the electromagnetic analysis at the new temperatures. Can we bring the temperatures from computed CFD to SC Motorsolve?
A: It can be scripted.

Q: Did FloEFD compute the vortices generated by each pin and their interaction to effect the heat transfer coefficient in realtime?
A: Yes, this is one of the main tasks in this example. The flow profile is calculated as a steady state simulation for each individual design point. Higher turbulences between the pins produce a higher heat transfer, which decreases the temperature of the components, but of course also causes a higher pressure drop.

Q: What are some cooling options to keep a rotor cool if you have a motor in a vacuum where radiation is the only thermal path available? The motor would be a brushless DC type design
A: Although this is a design question, according to my opinion, then you can maximize the radiation area, and if it is not enough then, you would have to introduce other cooling techniques like passive heat pipes embedded on the rotor. Or rotor interior liquid cooling which would require you to run the pipes out of the vacuum. Simcenter FloEFD can simulate radiation in vacuum. Please feel free to contact us again if there is a special application example you want to discuss with us.