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Validation Report of The New Conformal Cooling Solver

This report is aimed to introduce the newly developed conformal cooling solver which has better performance and Linux support. The detailed workflow is described in this report and the comparison between the new solver and old solver is also given.

Contents

Contents

Introduction **3**

Workflow **3**

Voxel Mesh **4**

Verification **5**

Conclusions **5**

Introduction

A new conformal cooling solver which solves the complex 3D printed cooling channels has been developed for 2019 release. This new solver is implemented with the highly parallelized code which can be faster than the existing solver, and this new solver also supports Linux.

Workflow

This new solver reuses the workflow of the existing conformal cooling solver with minimal changes hence is easy for users who have had the conformal cooling simulation experiences.

The steps for preparing the models are given below:

1) Import the 3D channel. The existing solver requires the 3D channel model must be CAD format, but the new solver loosens this requirement. The imported 3D channel can be more formats that can be meshed within Moldflow mesher.
2) Mesh the 3D channel. The existing solver uses the non-Moldflow-standard mesher to generate the mesh for conformal cooling channels. Again, the new solver loosens this requirement. The channel can be meshed with the existing method, or can also be meshed with the Moldflow standard mesher.
3) Set inlet and outlet boundary conditions for 3D channels. There is no change between the existing and new solvers. The new solver supports both the ordinary and rapid heating and cooling inlet boundary conditions.
4) Generate part and mold mesh.
5) Select conformal cooling solver. There is one extra option being added which allows user to select the existing conformal cooling solver and the new solver. The option can be found in the “Cool(FEM) Solver Parameters” dialog which is shown in figure 1.
6) Run analysis.
7) Check the results. There is no change between the existing and new solvers.

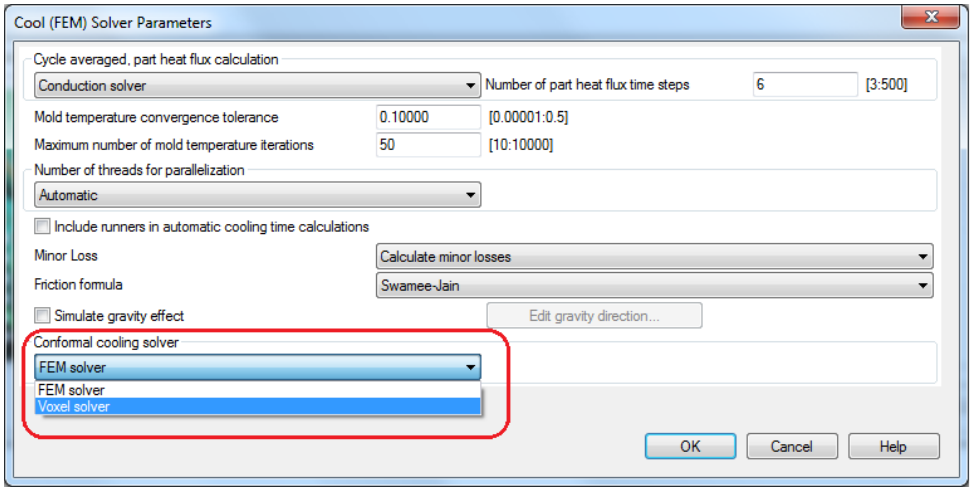

Figure 1 Conformal cooling solver selection

Voxel Mesh

Different with the tetrahedron and wedge meshes used in the existing conformal cooling solver, this new solver uses the “voxel mesh” technology. The voxel solver reads in the channel mesh and generate the voxel mesh based on it. The red region in figure 2 represents the original mesh and the blue region represents the voxel mesh. The new voxel solver solves the channel over the voxel domain.

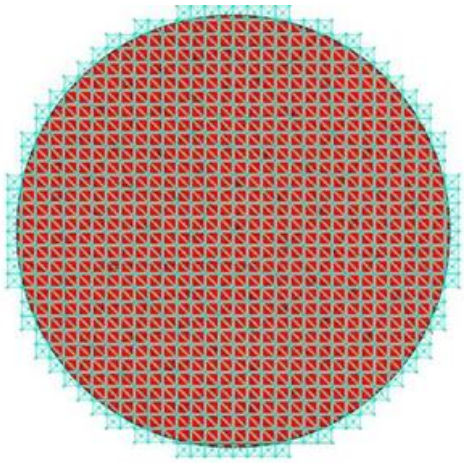

Figure 2 Voxelization

It can be seen from figure 2 that the voxel needs to be fine enough to represent the geometry accurately. The accuracy can be improved with the increase of the number of voxels, but more number of voxels also means the longer solve time and more memory usage. Hence the appropriate number of voxels is important. The solver provides two options to set the number of voxels: automatic and specified as shown in figure 3.

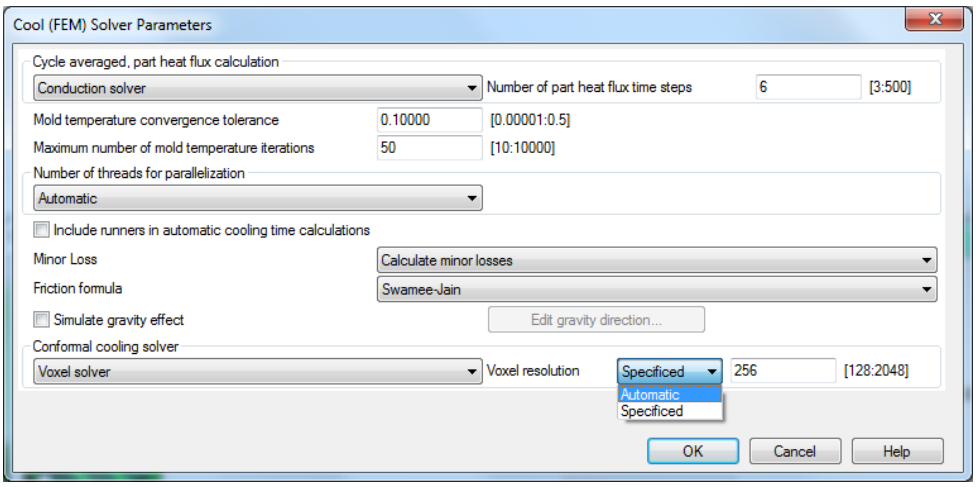

Figure 3 Voxel size determination

The automatic voxel size option tries to generate the minimal number of voxel meshes but can still solve the channel accurately. This is the default option and works well for most cases. If the automatic voxel size option doesn’t work well then user can specify the voxel

resolution manually. The allowed range for the voxel resolution is between 128 to 2048 which means the number of voxels along the longest dimension is some value between 128 and 2048, and the default number of voxels along the longest dimension is 256.

Verification

A conformal model shown in figure 4 is checked against the old solver and new solver.

Figure 4 Conformal cooling model. Model courtesy of of http://www.hofmann-innovation.com.

Table 1 shows the comparison between the new solver and old solver. It can be seen that both solvers provide the equivalent accuracy but the new solver is faster than the old solver.

	New solver	Old Solver
Cavity surface temperature – average (°C)	32.1061	32.2745
Mold exterior temperature – average (°C)	29.1538	29.1798
Solve time	11 min	4 hr, 39 min

Conclusions

This report introduces the new voxel based conformal cooling solver. This new solver can be used as an alternative to the existing conformal cooling solver with equivalent accuracy and faster solve time.

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