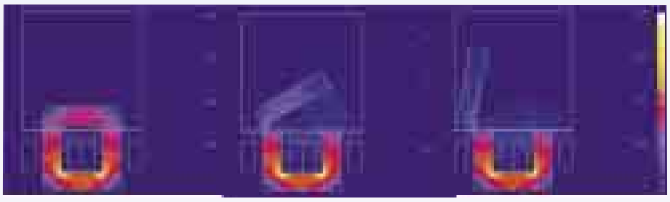
3D Motion in Magnetic Actuator Modelling.

Patrick Lombard, Christophe Guérin - CEDRAT.

A new feature has been introduced in FLUX version 8.1: the motion in 3D, including rotation or translation. This paper deals with the different types of motion available, the validation done, and the tutorial realised. This new feature has been introduced thanks to a strong collaboration with Schneider Electric and especially with C. Bataille and V. Leconte.

3D motion

A specific new feature allows to set the fixed part, the mobile part (in translation or in rotation), and the compressible part. When there is movement, the mobile part is moved, keeping its internal mesh constant, and only the mesh in the compressible part is rebuilt.
You can use this possibility either in multi-static computation or in transient computation, solving the mechanical equation. In this case, at the end of each time step, the magnetic force is computed and inserted in the mechanical equation in order to find out the position at the next time step. The mechanical equation includes the inertia of the mobile part, the magnetic force, the load force, the friction term and the spring.



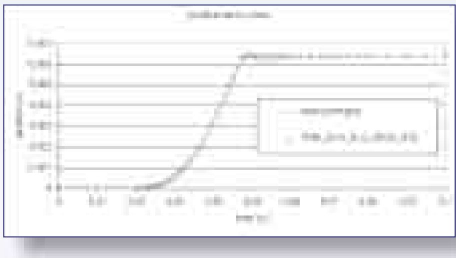
Application on a real actuator: computation and measurement

To validate this outstanding new 3D feature, we have applied it on different cases including one case on a real device. The electric circuit is made of a DC voltage, a coil and a switch. When the switch is on, the current rises, and the blade moves in order to close the air gap.

The measured data are the current, the position and the force, for 2 cases: multistatic positions and in movement. From the static part, one has deduced the stiffness of the spring which has been introduced in the mechanical equation. This stiffness is non-linear, and a tabulated function has been introduced in order to read values from table. The computation results have been compared with measurement, showing a good agreement.

Tutorial

From this example, a tutorial has been created, allowing to carry out the different analyses. This tutorial is already available, and is delivered in PDF format on the CDROM with all the FLUX documentation with Patch C of FLUX V8.1.



Position versus time.

FLUX: Using the Sliding Cylinder in 3D. (continued)

Marc Vilcot - CEDRAT.

storage or reduced storage), the control of the computation time (unlimited or limited) allowing a proper stopping of the solving process.

Under the "Results" menu, the usual post-processing capabilities are available for each angle, the passing from one angle to another being performed by selecting the desired value from the stored sample.

Moreover, time varying curves such as the torque vs. position are available. It has to be noted that for this simple problem, less than 10,000 nodes are enough to obtain the quality of the flux density distribution given (no smoothing applied on the results).
Finally, it has to be noted that the motion is obtained without any re-meshing. The method used by the sliding cylinder is based on a duplication of nodes. This allows the user to carry out an accurate computation of the torque with total freedom of choosing the required positions which are totally independent of the mesh generated.