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How to Speed Up Your Parametric Analysis Using Distributed Calculation in Flux®

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Today, even using FEM to reduce the time dedicated to designing equipment, it is not enough. We want to save even more time. This article deals with how to speed up your parametric analysis thanks to CDE (Cedrat Distribution Engine) directly available in Flux software. With this tool, it is possible to solve several parameter values (geometric or physic) in parallel instead of sequentially.

Fig. 1: Flux computations distribution among several computers. ***"With CDE save time and money".***

How does it work?

There are two ways of speeding up your computation thanks to distribution. You can use only the cores of your computer (single local node) or the cores of machines on the same network (multiples nodes). When Flux V12.1 is installed, CDE is directly configured to work locally so the computations can be distributed easily. It is also easy to use a number of computers on a network. For example, if your colleagues are only using a part of the performance potential of their computers, with the distribution manager, accessible from Flux supervisor, you can use the remainder.

How to choose hardware to distribute efficiently?

4 types of criterion are significant when choosing computer hardware:

- The first is processor: the higher the frequency, the quicker each job will be processed.
- The second one is the number of cores available; a solving scenario can be launched on each core, with a parameter value.
- The last is available RAM: each job uses the quantity of RAM assigned to the Flux project specially for 3D projects.
- The speed of the network.

A concrete example: a transient application from 0 to 10 seconds for three values of a geometric parameter. There are 4 cores and 16GB of RAM on the computer and 3GB are assigned to the Flux project: 3 cores and 9GB of RAM are going to be used for the project.

Examples of gain with HPC

The following table shows specifications of hardware used in the tests.

CPU	Intel® Xeon® E5-2687w v3
Clock frequency	3,1 GHz
Number of core per processor	10
Number of processor	2
Memory	128 GB
Number of nodes	20

Fig. 2: Hardware specifications.

> *Thanks to the CDE, it is possible to speed up your solving time and be more efficient, whatever the application (magnetic, thermal or electric) and the dimension (2D or 3D), with no loss of accuracy. Computations can be run directly on your computer, or even more powerful: on a cluster.*

» **The first case is an induction motor on a 2D magneto harmonic** application. We are looking for the torque for 6 values of voltage, and for each value of voltage we compute 130 values of slip. In the end, we have a solving scenario with 780 possible combinations.

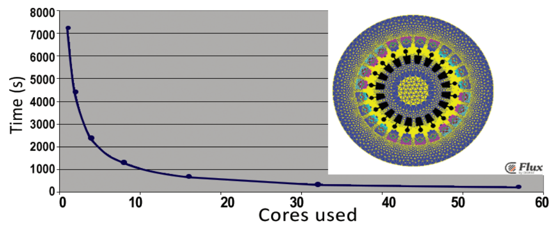

Fig. 3: Computation time as a function of cores used for a 2D induction motor.

The results are astonishing! A computation time equal to a long lunch break (2 hours) can become a coffee break computation time (11 minutes) with 16 cores. Moreover, **computation time is divided by 3 just using 4 cores**; this is the minimum number of cores available on computers sold today. Finally, we can see that with the help of other machines, the computation is finished in only 3 minutes and 20 seconds.

» **The second case is a 3D magneto static application of a switched reluctance machine**, with 1281 computation steps. In this case too we can observe the power of CDE. A computation time of 31.5 hours can be reduced to 1.5 hours with 52 nodes. Furthermore, with only 4 cores, CDE divides the computation time by 2.3 (13 hours 40 minutes).

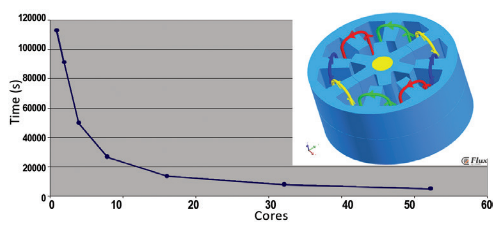

Fig. 4: Computation time as a function of cores used for a 3D switched reluctance motor.

Overall, we obtain a gain greater than the number of cores halved compared with conventional, non-parallel computing.

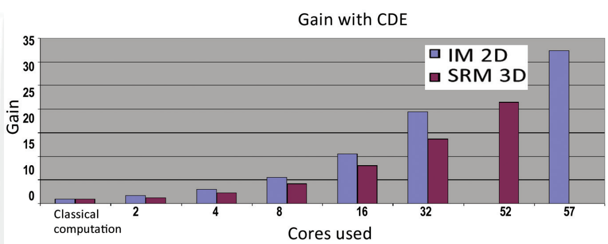

Fig. 5: Gain with CDE compared to the conventional non parallel computing.