Advanced methpds for numerical analysis and computer science

Stella Krell

Many complicated physical phenomena can be modeled by partial differential equations (PDE). Since these equations can not be solved analytically, they are then discretized and solved approximately on a computer. Processing speeds and memory sizes have steadily increased over the last decades, but finally reached about twenty years ago their long predicted plateau which can not be overcome any more with the same technology.

In order to use these large scale parallel computers effectively for approximately solving PDEs, new parallel algorithms had to be developed. Domain decomposition methods are naturally adapted to run in parallel, and especially suited for modeling complex problems. They allow users to structure their problem and domain on which it is posed naturally by forming subdomains. We will focus on the diffusion equation. The first domain decomposition method was invented in 1870 by Hermann Amandus Schwarz. The outline of the lecture is the following:

- Presentation of the continuous Schwarz methods in 2D.
- Discrete Schwarz methods on general meshes in 2D.
  - Study of the two points flux approximation (classical strategy).
  - Study of a more general method called Discrete Duality Finite Volume.
- Numerical simulations using scilab.