INTERNSHIP PROPOSITION FOR 2009

Laboratory: DEN/DANS/DM2S/SERMA/LTSD
(Laboratoire de Transport Stochastique et Déterministe)
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Duration: 4 to 6 months (starting approximatively in April)

Financial conditions: 700 euros/month gross (around 550 euros/month net), possible accomodation allowance around 220 euros/month and a bonus at the end of the internship.

internship Title:
Analysis and development of a non-linear iterative method based on the two-step transport-diffusion scheme for nuclear reactor core calculations.

Subject Description:
The calculation scheme for nuclear reactor cores is based on a two-step physical modeling; the first modeling is at the assembly scale while the second is at the core scale. The neutron flux in a fuel assembly is analyzed in an ideal infinite network of the same assembly by numerically solving the transport equation. The energy mesh, the angular mesh and the spatial mesh for the assembly flux must be very detailed. Indeed such a flux will provide the neutron spectrum necessary for the homogenization in space and the condensation in energy. This process builds-up the few-group homogenized cross-sections for the assembly that feed the core modelization. At the core scale, the calculation is performed using a coarse energy mesh (2 or 4 groups) and by considering each assembly as a homogeneous material.
Because of the infinite lattice approximation, the transport calculation introduces inevitably errors in the homogenization process. These errors are very difficult to monitor and control. In this internship, a new two-step scheme is proposed: the non-linear transport-diffusion equivalence is calculated iteratively to take into account the interface effects at the boundary of each assembly. The iterative process will be initiated by an infinite lattice calculation.

Then, a coarse operator (coarse in space, in energy and in angle) will be built dynamically during iteration across the core by utilizing a transport-diffusion equivalence based on the conservation of the neutron balance. This calculation will provide the entering current in each assembly and the k-effective of the core to reiterate a new transport calculation at the assembly scale. This process will take into account the real boundary conditions for assemblies.

The candidate will work with the IDT transport solver that solves the transport equation in XYZ geometry using the discrete ordinates approximation for the angular variable and the methods of short characteristics or nodal for the spatial variable.

A deep knowledge of the Fortran90 language programming is strictly demanded.