Programs LUCKY & LUCKY_C – 3D Parallel Transport Codes for The Multi-Group Transport Equation Solution for XYZ Geometry By Pmsn Method

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These programs were developed to resolve large shield tasks (LUCKY) and complex critical systems for K-eff value (LUCKY_C) by MBC-1000 supercomputer (768 Alpha-670 Mhz processors).The parallel geometry space mesh generator lets make input data by users **so very simply** and view geometry for the task by AUTOCAD program. These codes may use multi-group cross-section library in GIT format up to P8 approximation. LUCKY & LUCKY_C have imbedded S2-S16 quadrature's sets to approximate the solution.

Main positions of the parallel technology for LUCKY & LUCKY_C codes

1. MPI service between processors exchange
2. The geometry space for the task is break up at any number of space parts (objects)
3. Every object for LUCKY is calculated by one processor (space paralleling)
4. Every object for every energy group for LUCKY_C is calculated by one processor (space & energy paralleling)
5. The exchange between objects are carried out by neighbors fluxes or by energy scale
6. Number of processors is unlimited
7. The solution may be received by the iteration process for every energy group

LUCKY & LUCK_C may work as with angular fluxes as with moments of angular fluxes.

The algorithm was created specially for "vector-processor" but unfortunately one is not available at MBC-1000 supercomputer and we can't test these programs for full power. Nevertheless the real efficiency for parallel processes is not less then 0.4 even for large processor numbers (512-768). The huge resource of this supercomputer lets use space mesh steps about 1 millimeter to create the approximation for the transport equation and to describe complex geometry structures. Under these conditions we can use XYZ geometry as universal one. The space object may have about 1-2 million space mesh points under S8-S6 approximation. Thus the total number of space points may be up to 1000-1500 million one. But the ordinary calculation has about 300 million of total space points (the space step about 1. – 5. millimeter) for 30 energy groups by P5S8 approximation and 512 processors. This task takes time ~ 600 minutes. To optimize the iteration process we use "2 levels" Gauss acceleration method ("between" objects and "in every" object). This effect is about 1.3 for neutron's groups and about 1.8 for gamma's groups and this effect depends from the energy group and material properties. Thus the iteration number is about 8-15 for gamma's groups and no more 15-40 for neutron's ones ordinary. Moreover there is the optimal technology to break up the geometry space for objects to obtain the maximum parallel efficiency for the task.

LUCKY code was used to resolve some practical shielding tasks. The results for "БРЕСТ" (X-size 7 meter, Y-size 2.5 meter, Z-size 2.8 meter) shielding task obtained by DORT and LUCKY will be presented.

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