Philosophy, Principle, and Method for the CombLayer: Day Four

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December 14, 2015

Variance Reductions

CombLayer has a number of variance reduction methods :
Nothing here is more than undocumented bolt on actions to solve specific problems
Many depend on MCNP modifications

- DXTRAN spheres
- EXT cards
- WWN modifiers
- PD modifiers

Monte-Carlo engine

There is a full neutron Monte-Carlo transport code within CombLayer – source/transport/scattering/detectors.

Simulated a whole experiment [D4C]

Often forgotten facts about variance reduction

Variance reduction is best though of as minimizing the varance of the variance of the tally.

1. The number of initial source particles is unlikely to be important
   - The source distriction needs to be sampled no bettter than $\sqrt{2}$ better than the tally distribution
   - A volume distribution need to be sampled no better than $\sqrt{2}$ better than the tally distribution
   - A volume unit need to vary less than $\sqrt{2}$ better than the tally distribution

Often forgotten facts about variance reduction

2. The workings/not-workings of forward-bias methods are debated to stupidity.
   - Point tallies/dxtrans are forward bias techniques
   - They approximate beyond the model threshold
   - The model threshold is 1GeV for TENDL and 200MeV for ENDF-VII.
   - If you **cannot** run a quick >100MeV solution without forward biasing **Game over**

EXT Card

The EXT can biases the direction of the particles in the same way as a weight window
Set in a two part process

- Scaling needs cells to apply to
- Direction to ally to / point to track to

```
1
2   ./myBox -r -wExt Object TubeObj scaleVec 0.5 'Vec3D(3,4,5)' AA
```

WWN System

If cell based variance reduction is required (normally is):

- It is applied as a set of modifications to a default
- Large level of source code only documentation

```
4
5  ./ess -r
6       -w \
7       --weightType high \
8       --weightSource 'Vec3D(600,0,14)' \
9       --weightTally 'Vec3D(1600,0,14)' \
10      --weightObject ABunker:Sector4 1.0 0.1 1e-5 \
11      --weightRebase object ABunker:Sector4 0 1.0 \
12       AA
```

–weightObject ECut scaleF minWt

ECut	Only work with energys above (below) this number [-ve means below]
scaleF	Density scaling factor
minWt	Minimum weight factor

–weightRebase object ObjectName linkPt newMaxValue

ObjectName	Name of link object
linkPt	linkPoint [signed]
newMaxValue	Value to set max point to (rescale others)

WWN System

- -w card is manditory (if a number given then changes the distance $1/r^2$)
- weightType controls the energy ranges
- Source/Tally pair does a pseudo simulation from A $\rightarrow$ B

Adding DXTRAN

Forward biasing –
REALLY REALLY think about changing MCNP to support non-spherical DXTRAN.

```
13
14 ./ess -r
15       -w \
16       -wDXT free 'Vec3D(3,4,5)' 50 \
17       -wDD -0.01 30 \
18        AA
```

- DD card is BOTH diagnostics AND control!!

Adding pd cards

The equivilent fo DD card for point tally is the PD card.

```
19
20 ./ess -r
21      -w \    Required
22      -T point object Mybox back 4.0   \
23      -TW AA
```

- There are pitifuly few options to this card
- MCNP only allows one value [not an energy range value]
- I overcome this by coding up ranged point tally into MCNP