Network Generation Code

The program uses a fixed format input file. The input data file can be supplied as an argument to the executable.

```
C:\>networkgen.exe default.dat
```

This program will generate network data files that are consistent with the reconstructed sandstone networks generated by Statoil, and can be supplied to the network simulation code. It is important to note that the networks generated by this program are not based on any sandstone reconstruction, but rather based on a regular cubic lattice (with the possibility of reduced connectivity). The networks are constructed with periodic boundary conditions. Questions regarding the code or input file can be directed to Per Valvatne at Imperial College (p.valvatne@ic.ac.uk).

Input file description

```
cubic                          % Base file
```

The network data will be written to 4 files (in this case *cubic*_node1.dat, *cubic*_node2.dat, *cubic*_link1.dat, *cubic*_link2.dat). This line indicates the prefix to the file names.

```
20       10        10           % Lattice size
```

This indicates the size of the cubic network (in this case 20 × 10 × 10 pores).

```
1.0   18.5   0.2   3.0    % Min throat radius, max throat radius, delta exp, eta exp
```

All properties (in this inscribed radius of throats) are distributed according to truncated weibull distributions

$$r = (r_{\max} - r_{\min})\left(-\delta \ln\left[x\left(1 - e^{-1/\delta}\right) + e^{-1/\delta}\right]\right)^{1/\gamma} + r_{\min}$$

where x is a random number between 0 and 1. The radii are in μm (1.0E-6 m).

```
20.0  50.0   0.3   2.0    % Min throat length, max throat length, delta exp, eta exp
 0.5   2.0   0.2   3.0    % Min aspect ratio, max aspect ratio, delta exp, eta exp
```

The inscribed radius of pores is found by multiplying the average radius of the connecting throats by an aspect ratio, α, with the constraint that the pore radius must be larger than the largest connecting throat radius.

$$r_p = \max\left(\alpha \frac{\sum_{i=1}^{n_c} r_i}{n_c}, \max(r_i)\right)$$

The lengths of the pores are taken to be *2×radius*.

```
0.001   0.04811   0.8   1.6   % Triangles: Min G, max G, delta exp, eta exponent
```

The shape of the pores and throats are determined by the shape factor, *G*. The shape factor is a dimensionless variable relating the area *A* of the element to its perimeter, *P*.

$$G = \frac{A}{P^2}$$

Triangular elements have shape factors ranging from 0.0 (slit-shaped) to 0.04811 (equilateral). Square elements have a shape factor of 0.0625 and circular ones 0.07958 (1/4π).

```
0.20     0.05           % Pores: proportion of square and circular pores
0.15     0.00           % Throats: proportion of square and circular throats
```

Most of the elements in the networks will typically have triangular cross sections. However, it is possible to have a certain proportion of the elements having square or circular cross sections. Circular elements are characterised by the fact that they can only contain a single fluid.

```
0.25                    % Proportion of pore volume occupied by clay
```

When matching data it is important to match the residual water saturation. It is therefore possible to add a uniform clay volume to all elements (as proportion of total element volume). This volume is taken as containing water that cannot be drained, effectively indicating a residual water saturation of the network.

```
4.5                       % Average connection number <= 6
```

A regular cubic lattice will have a connection number of 6 (six throats connected to each pore). It is however possible to reduce the connectivity of the network by randomly removing throats.

```
T                         % Use periodic boundary conditions
```

Should one use periodic boundary conditions on the y and z faces of the model?

Data file example

```
cubicNet                        % Base file
20      10       10             % Lattice size
 1.0  18.5       0.2   3.0      % Min throat radius, max throat radius, delta exp, eta exp
20.0  50.0       0.3   2.0      % Min throat length, max throat length, delta exp, eta exp
 0.5   2.0       0.2   3.0      % Min aspect ratio, max aspect ratio, delta exp, eta exp
0.010   0.04811  0.8   1.6      % Triangles: Min G, max G, delta exp, eta exp
0.10  0.05                      % Pores: proportion of square and circular pores
0.15  0.00                      % Throats: proportion of square and circular throats
0.22                            % Proportion of pore volume occupied by clay
4.8                             % Average connection number <= 6
T                               % Use periodic boundary conditions
```