DISCUSSION FOLLOWING SESSION NO 3

Chairman: Margaret Armstrong

Papers: Ravenscroft; Bremond & Jeulin

After both paper's were finished, the chairman asked if there were any questions on Jeulin's paper.

Séguret: My question has 3 parts to it:
1) How do the results depend on the initial germ?
2) What criterion is used to stop the iterations?
3) I agree concerning the Navier-Stokes property but do these simulations respect any special statistics such as the correlation function. Is this possible?

Jeulin: In reply to the first question, clearly if I have an aggregate like this (he points to a transparency) then I know that this point was the origin of the coordinates. In this case we just wanted to simulate a random set (a random compact set at the origin). Then if you use a Poisson distribution of points you can simulate nucleation at Poisson points and then growth. You can change the process as well, so you have considerable freedom in what you do.

Second point, concerning the number of iterations, we start with a given suspension density and during the time the suspension lands on the aggregates and so the suspension concentration outside the aggregate drops. Consequently the process stops when there is no more in the suspension. If you continue to introduce suspension, the process stops when the whole region is full, except for parts that can no longer be reached due to the connectivity. In the present case, there are a limited number of particles so the process stops when these have all be used up.

Last point concerning the statistics, we do not know much from theory. For example, the geometrical covariance is unknown for this kind of model. But these can be measured at different times on the simulations. For example here we see that it is a power law behaviour at the origin. We also measured the covariance for the population of aggregates. The results are given in the paper. The statistics can be measured on the
simulations and not given by a theoretical calculation. What is interesting here is to study the dynamics of the system; for example, the evolution of the area of the aggregates with time. Here it is not uniform. And so you can study the physics of the growth process that is behind your model. I repeat this has to be done experimentally from the simulations. It seems to be hard to calculate the geometrical covariance or the Choquet capacity theoretically.

One thing that, in my opinion, is important for the quality of the simulations is to look at the simulations and compare them with reality. There is a lot of information in their shape. You can compare them visually with the real objects that they are supposed to model, and decide whether or not they look alike.

Armstrong: This question is for Peter Ravenscroft. This morning in Carol Gotway's talk we were looking at 4 particular loss functions all related to environmental science. Coming back to mining, what types of loss functions would you suggest using to compare simulations with reality?

Ravenscroft: Initially, one should check the things that one had set out to reproduce (the covariance function and the histogram). Now for loss functions, I would be interested in the distributional aspects such as the quantity above a given cut off grade. You should produce something which matches what you want — which matches reality, in the range that is of practical importance. I think you should concentrate on the distributional aspects or cutoff criteria.

Kleingeld: Peter, if you do not have enough data to get a good estimate, why should your simulation give a better impression of the deposit? Do you believe you can?

Ravenscroft: No, the converse is probably true. If you cannot get a decent linear estimate, you will probably get a bad simulation. If you are doing multiple simulations, then in that case your simulations turn out to be very spread out. One of the things that I should have said earlier, is that the power that I see in the conditional simulation approach is that you start out with a global parametric model (in terms of the variogram and the histogram) and if you have areas of the deposit where your data show departures from that model, then your conditional simulations will depart from the model as well. So the simulation will actually turn away from the model and match the data, where there is enough data.

Kleingeld: So we come back to the concept of having enough data because one problem that we must face, is of getting a given variogram and histogram from different underlying models. So the variogram/histogram criterion