Three layers model:

|  |  |
| --- | --- |
| Number of rows | 40 |
| Number of columns | 35 |
| Number of layers | 3 |
| Row spacing (delta y) | 2.0 m |
| Column spacing (delta x) | 1.5 m |
| Thickness of first layer | 8.0 m |
| Thickness of second layer | 14.0 m |
| Thickness of third layer | 18.0 m |

Confined, with specified head boundary conditions (tilt) on first and last columns. Three wells (one for each layer on the same vertical line), 12 observations for each layers, a total of 36 observations.

A total of 4200 parameters, 1400 for each layer. Each layer corresponds to a different beta association. Added noise to observations.

Files K1.txt, K2.txt, K3.txt contain the true field for each layer (1 is the upper layer).

Results, tests and concerns:

* Using normal and compressed, even toeplitz, covariance matrix form, the results are the same starting with the same parameters. Also in case of prior information on beta, compressed form and toeplitz works fine. Posterior covariance works fine too with compressed and toeplitz.

I tried also a 3 layers model (with same z spacing) with one beta association (the same for all the layers) to test toeplitz stuff also in z direction and it works fine.

* Structural parameter optimization with linear variogram on each beta association works fine, during the structural parameters optimization the results get better and seems to me that the structural parameters are estimated well.

I tried also to use the exponential variogram and a mix of exponential and linear variograms (for the different beta association) and the results are good.

Can we use a combination of linear and variogram with more than one beta association? I don’t remember if there is a problem with authorized covariance or something like that. It was something that I read in your phd thesis.

* I tried also to change the initial values of the structural parameters. At the end the solutions are not too different. Nealder Mead in the structural parameters optimization, gives almost the same results at the end.
* Right now in the linesearch procedure we start with *rho*=0.5 and we adopt a *step* for the initial simplex of 0.5. This means that at the first linesearch iteration *rho* is 0.5, at the second is *rho* = 0.5+0.5 =1., the third is 0.5-0.5=0. and then the algorithm decides the next value of *rho*. I found that sometime, using a small number of iterations, the value of *rho* that give the minimum objective function is zero (especially after 3 or 4 bga iterations). If we use a different *step* for the initial simplex (0.3 for example), the first 3 values of *rho* tried by the algorithm are 0.5, 0.2 and 0.8 respectively and the *rho* value that gives the minimum objective function is different (and different from zero). It is not a big problem, at the end the solutions are very very similar. But we should decide if the value of 0.5 for the initial *rho* and the *step* is fine or if we want to allow the user to set both the initial value and the step from outside.
* Use of PEST to calculate derivatives, gives a final solution a bit different respect to the use of adjoint. I found also that using a different DERINC gives differences (in this case for example a value of 0.05 instead of 0.01, seems to me that gives better result). We should decide also here if we want to allow to set DERINC from outside.
* Also for the structural parameter optimization routine (Nealder Mead routine) the value of the *step* (that is a vector of dimension the number of structural parameters) for the initial simplex can help to reach the solution faster. Also here we should decide the best value of the *step* (now *step* is equal to the initial value of parameters). We can also allow to set it from outside in some way.
* I tried also to change the order of the parameters when supplied and the results are the same.