

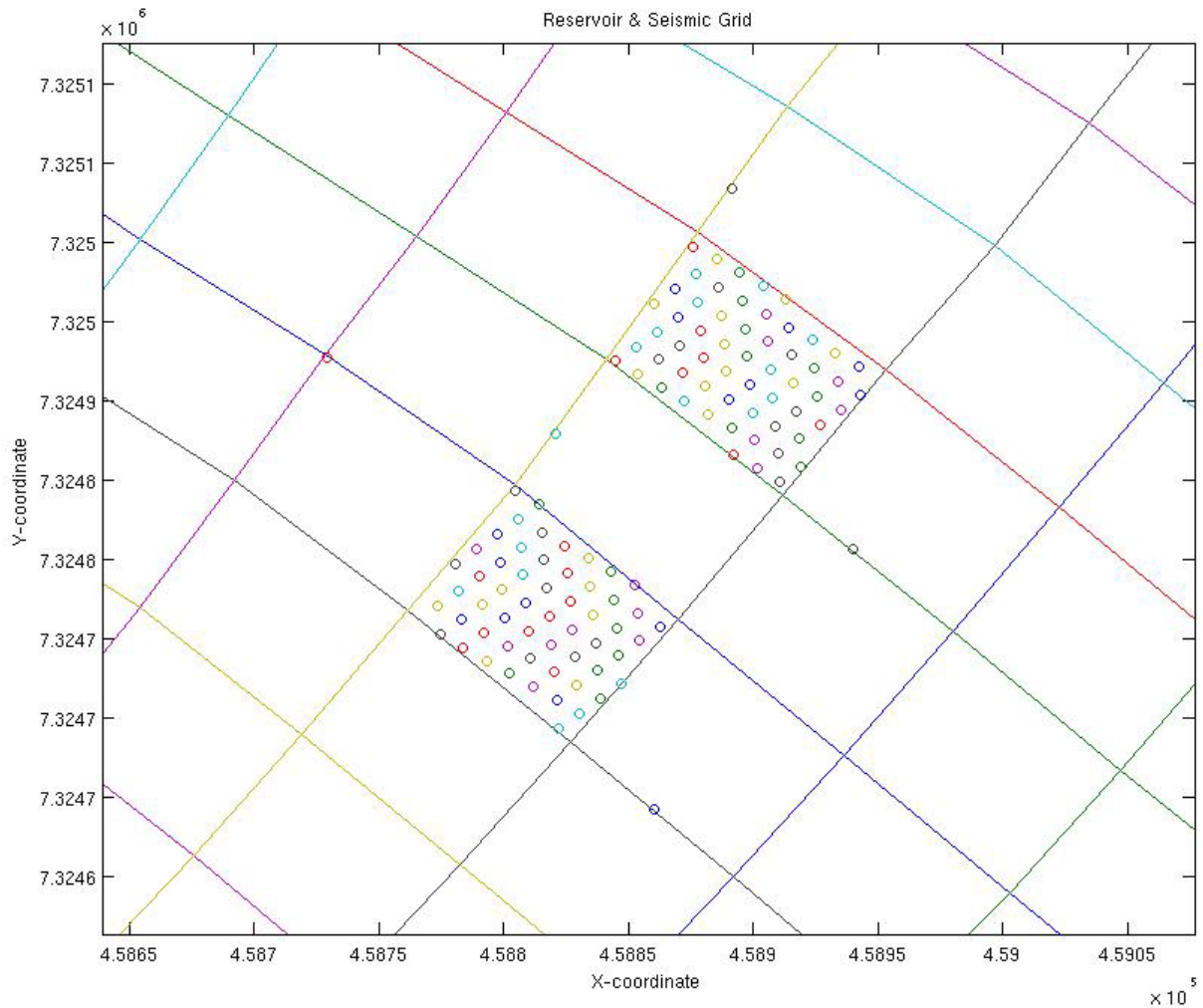
# MODELING OF 4D SEISMIC RESPONSE AT THE NORNE FIELD

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## **ABSTRACT**

A time lapse seismic forward modeling study of an offshore producing oil and gas field in the Norwegian Sea is being developed. Forward modeling of 4D seismic data is an important tool in both feasibility studies and interpretation of time-lapse data. By combining rock physics modeling and fluid-flow simulation, the seismic parameters,  $V_p$ ,  $V_s$  and densities can be calculated at different times for different fluid states. A 3D modeling code will then be used to predict the seismic response. The first step of the modeling is to create an isotropic seismic model on a regular grid, populated with values of  $V_p$ ,  $V_s$ , and density at each node. The seismic grid then needs to be linked to the reservoir simulation grid so that velocities and densities can be calculated as a function of reservoir parameters. The reservoir simulation grid is much coarser than the seismic grid, and it consists of cells instead of nodes. Further, the reservoir simulation grid is not a regular grid but based upon corner point geometry. To check if a seismic node is horizontally within a reservoir simulation grid cell, a vector is calculated from one of the corners of the cell to the seismic point. If the seismic node is within the cell, then the angle between the corner lines should be larger than between each of the corner lines and the vector. If this is true for all corners in the cell, the seismic node is horizontally within the cell.



**The figure shows a few reservoir simulation grid cells divided by lines, seen from above. Two of the cells, have been filled with corresponding points in the seismic grid, using the algorithm described above. A few seismic points fall outside of the two reservoir grid cells, caused by an inaccurate angle calculation in the algorithm. These points represent only a small fraction of the total number of nodes, so this is not assumed to be an important issue.**