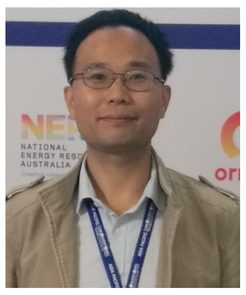
Automatic 3D geological modelling with ArcGIS Engine: A new approach for surface and subsurface data integration



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Problem definition and aim

The geosciences space is a continuous three-dimensional domain. Currently most three-dimensional geological models do not include the surface (topography).

A 3D geological model that also integrates the surface and subsurface is of significance for selecting the location and drilling design of coal bed methane wells. This can reduce production cost and increase gas production.

ArcGIS is powerful in 3D geographical modelling, but weak in 3D geological modelling. We examined the potential of extending ArcGIS capabilities to achieve the integration of 3D geospatial data of surface and subsurface and realise geological modelling

3D geological modelling is a difficult task for GIS, especially in automatic modelling. Automatic modelling can reduce the complexity of 3D geological modelling, reduce the workload, and improve work efficiency for geologists. It is an effective way to quickly achieve integrated modelling for 3D surface and subsurface data based on a GIS software system.

Strategy for geospatial data *integration*

Based on multi-source geospatial data from ground and underground surveying, the proposed data integration strategy for 3D geosciences modelling based on the ArcGIS engine is shown in Figure 1.

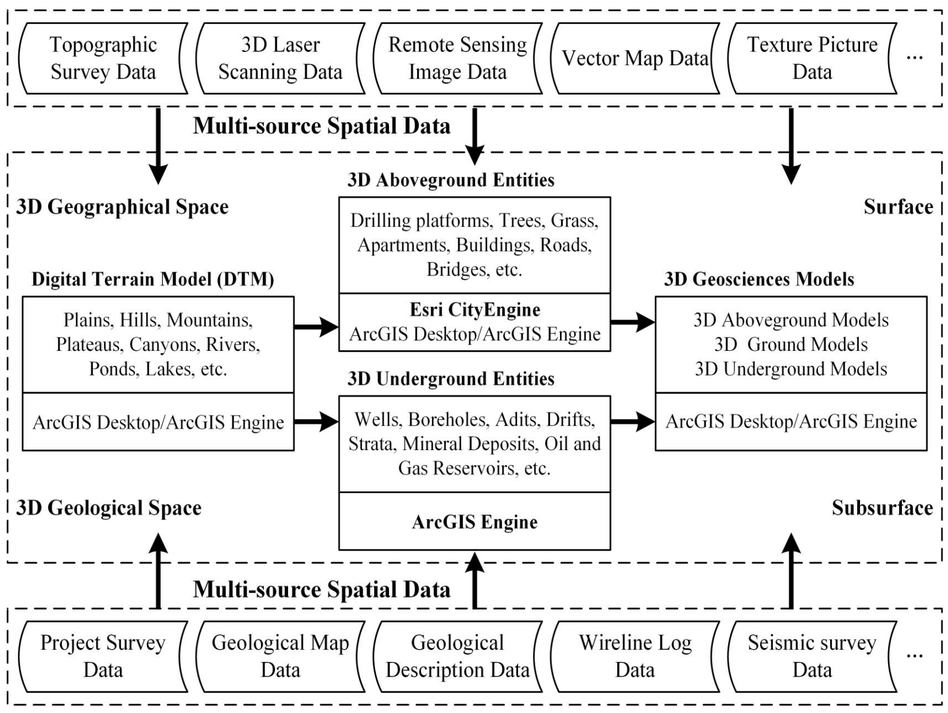


Figure 1: *Integration strategy for surface and subsurface geospatial data*

Methodology for automatic geological modelling

ArcGIS Engine components and Visual Studio C# is the software development platform. An object-oriented approach is used to decompose, optimise and combine the workflow
of 3D geological modelling. Functional software modules are developed based on MultiPatch geological structures. The system functions are integrated to realize the automatic 3D geological modelling. The main functional framework and workflow of the system are shown in Figure 2.

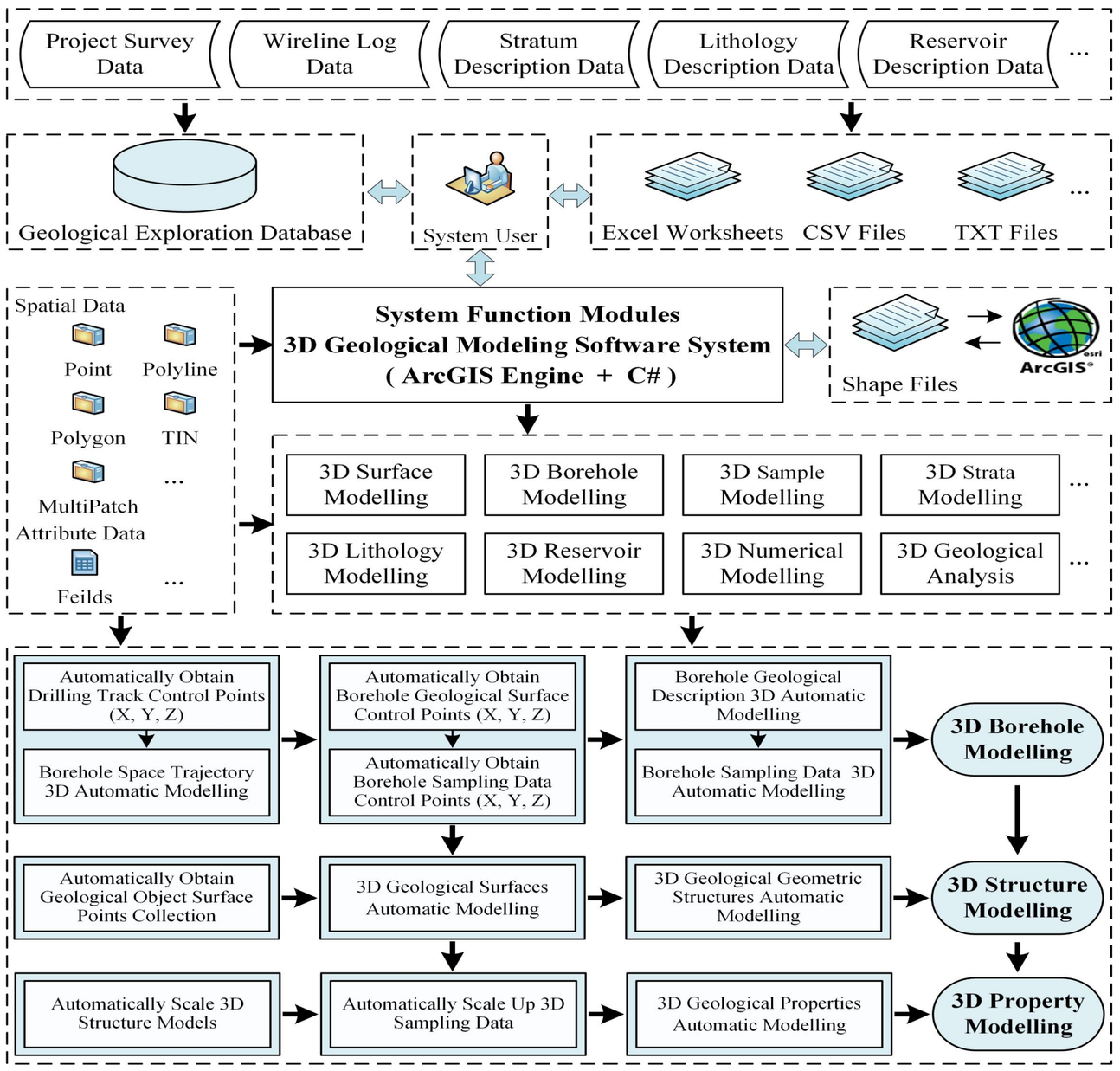
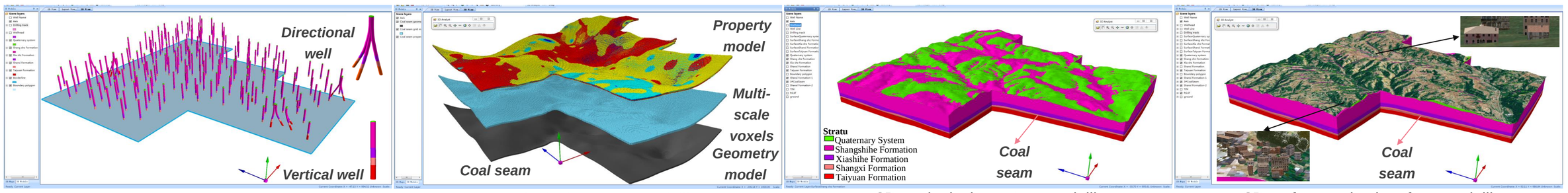


Figure 2: *Framework and workflow of 3D geological objects auto-modelling system based on ArcGIS Engine*

3D geological modelling

The Digital Terrain Model (DTM) is built referring to ground vector maps and tenements. Next, vector maps, remote sensing images, and texture pictures are integrated into a high-resolution 3D surface model with ArcGIS Desktop, Esri CityEngine, or ArcGIS Engine, such as buildings, bridges, trees and vegetation. Similarly, 3D geological bodies are built automatically by developing ArcGIS Engine components, such as wells, strata and reservoirs. Terrain and underground 3D models are integrated by using ArcGIS Desktop or ArcGIS Engine software platform (refer Figure 3).



3D wellbore modelling | 3D geological property modelling | 3D geological structure modelling | 3D surface and subsurface modelling

Figure 3: *Functions implementation of 3D geological modelling system based on ArcGIS Engine*

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