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A service integration platform for geo-simulation in the distributed network environment

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To date, to solve geographic problems across different regions, scales and domains, many institutions and researchers across the globe have developed various geographical analysis models. With so many model resources existing, it would be a waste if they could not be shared and reused. Moreover, when dealing with comprehensive geographical problems, one single model cannot meet the requirements of a complex simulation. Therefore, model integration with the existing model resource is required. Due to these two reasons, developing geo-simulation platforms with model sharing and integration has currently become a popular topic.

The above-mentioned types of geo-simulation platforms and related frameworks have passed through several stages, which are integrating modelling and simulation with hard-coding, component-based integration and simulation, and service-oriented integration and simulation. However, there continue to be some problems that require further discussion. In the network, preparing data for models, establishing logical relationships between different services, and controlling the integrated simulation in a collaborative and convenient way, are all key points under consideration.

With the aim of finding solutions for these key points, this article proposes a service integration platform in distributed network environment. The platform consists of three layers: the service preparation layer, the integrated modelling layer, and the collaborative execution layer.

The service preparation layer provides model resources and data resources for service generation, which is the foundation of integrated modelling and simulation. It includes two parts, which are resource encapsulation and service management. The former converts heterogeneous simulation resources into standard models, which could be shared and reused in the web environment. The latter manages model and data resources including service publishing and invoking.

The integrated modelling layer was divided into two parts, which including conceptual modelling and logical modelling. Conceptual modelling was designed to abstract and express the geographic phenomena using conceptual diagrams. Logical modelling matches conceptual diagram with computable entities, i.e. model services and data services.

The collaborative execution layer mainly refers to two kinds of collaborations, which are, collaboration among computing servers and collaboration among modellers. Collaboration among servers includes event message distribution, service requesting and redirection based on the network structure, and monitoring of server and service status in the web environment. Collaboration among modellers includes collaborative intervention and regulation of parameters, design and comparison of solutions collaboratively, and collaborative visual analysis of results.

Models in TAU DEM are used as an example to test the practicability of the proposed platform. TAU DEM models (e.g., pit removal model, flow direction model, flow accumulation model, threshold model, and stream network model), and data processing methods (e.g., refactoring between GeoTiff and ASCII Grid) are encapsulated, published and deployed in different servers. Then the integrated model is built following the steps of conceptual modelling and logical modelling. Finally, the data is configured collaboratively, and services are invoked for visual analysis.

Keyword: model sharing and integration, service integration platform, geo-analysis model, geo-simulation