공간 일정 계획의 이슈들과 접근방법
Issues and Approaches to Spatial Scheduling

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ABSTRACT

In large-scale industry such as shipbuilding, aircraft manufacturing, and construction industry etc., it is required to consider two or three-dimensional spatial availability as one of bottlenecked resource constraints. We call this kind of scheduling a **spatial scheduling**, which considers the dynamic spatial layouts of objects as well as the traditional resource constraints. Since 1991, we have researched on the spatial scheduling for shipbuilding plant (Lee & Lee, 1992; Lee et al., 1994, Lee et al., 1995). In this paper, we present the various issues of spatial scheduling for the researchers and developers attacking spatial scheduling problems.

Taxonomy of Spatial Scheduling Problem

We can classify the spatial scheduling features affecting the solution approach.

◆ The shape of spatial objects

The shape of spatial objects in spatial scheduling can be various such as rectangles, convex polygons, simple polygons, and arbitrary shapes. In real world problems, it may be possible to approximate the original shape to the simpler shape. In shipbuilding, the shape of the spatial objects can be approximated to simple polygon without loss of solution quality (Lee et al., 1994). When spatial objects are not orthogonal, the spatial scheduling procedure involves complex spatial or geometric problem solving and require the computational geometric algorithms (Lee and Preparata 1984). In the case of arbitrary shapes, the hierarchical data structure (Samet, 1990) will be considered as the representation scheme.

When the approximated shape is rectangular, the approach of the spatial scheduling can be similar to that of the three-dimensional packing problem. Li and Cheng introduced three dimensional packing problem as a model of job scheduling in partitionable mesh connected systems (Li and Cheng 1990).

◆ The number of orientations of spatial objects

The number of possible orientations of spatial objects can be one, finite, or infinite. Of course, the 'fixed or finite' orientation case is simpler than the 'infinite' case. But that case is usual for a large variety of spatial planning application [du Verdier 1993]. In that case, the configuration space approach (Lozano-Perez 1983) is expected to be useful for the representation scheme.

◆ Characteristics of non-spatial resources

Besides spatial resources, there can be multiple non-spatial resources such as manpower, equipment, etc. So, it is also a typical large-scale scheduling problem. The coexistence of the generality as a scheduling problem and the specialty as a spatial layout problem is most unique feature of spatial scheduling.

View on Spatial Scheduling

To what the spatial scheduling problem belongs in the literature? It can be said that the spatial scheduling problem belongs to Spatial or Geometric Constraint Satisfaction Problem [Kramer 1992; du Verdier 1993]. It is comparable to the fact that there have been many researches viewing scheduling problems as Constraint Satisfaction Problem [Zweben et al. 1992]. Another aspect to spatial scheduling is viewing it as a multi-dimensional allocation problem. In case of orthogonal problem, the spatio-temporal problem can be decomposed into a set of 1-dimensional problems, which can be solved much more easily than the original problem [Tanimoto 1993]. But in polygon world, the problem cannot be simply decomposed to a set of simpler problems. Besides the spatio-temporal dimension, spatial scheduling has resource dimension. The number of resource dimensions is the same as that of resource types. Considering the characteristics of the various dimensions, integrating them and balancing efforts upon them become important issues.

The research on the spatial scheduling includes the following issues and we will present our research on the part of them.

- Spatial layout methodology at a decision point
- Spatio-temporal allocation methodology
- Look-ahead load analysis and load balancing for multiple resources
- Reactive and visual interactive spatial scheduling
- Implementation of general spatial scheduling kernel
- Approach variation according to the different domain characteristics

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