# AUTOMATION METHOD TO IDENTIFY THE GEOLOGICAL STRUCTURE OF SEABED USING SPATIAL STATISTICAL ANALYSIS OF ECHO SOUNDING DATA

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**Abstract -** Recently construction of subsea tunnel has been increased globally. In Korea, subsea tunnel construction project to link the Korean Peninsula to Jeju Island has been drawing more attention. For safe construction of subsea tunnel, identifying the geological structure including fault at design and construction stage is more than important. Then unlike the tunnel in land, it's very difficult to obtain the data on geological structure because of the limit in geological survey. This study is intended to challenge such difficulties in a way of developing the technology to identify the geological structure of seabed automatically by using echo sounding data.

**Index Terms -** Geophysical investigation, Geological structure, Subsea tunnel, Spatial statistics, Echo sounding

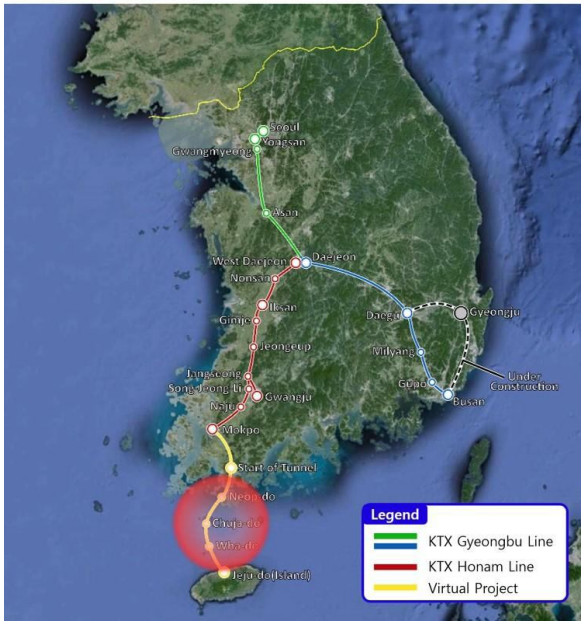


**Fig. 1 Subsea tunnel construction project in Korea.**

When investigation a potential site for a deep subsea tunnel, there is the technical and economical limit with borehole and geophysical investigation. On the contrary, echo sounding data is easily obtainable while information reliability is higher comparing to above approaches. The study on identifying the geological structure indirectly by applying spatial statistical analysis method to topographic information on seabed which is obtained by echo sounding data was conducted. This study is based on structural geology indicating that topographic features incorporate geological structure. This study is aimed at developing the algorithm that identifies the large scale of geological structure of seabed using geostatic approach. This study is based on theory of structural geology that topographic features indicate geological structure. Basic concept of algorithm is outlined as follows; (1) convert the seabed topography to the grid data using echo sounding data, (2) apply the moving window in optimal size to the grid data, (3) estimate the spatial statistics of the grid data in the window area, (4) set the percentile standard of spatial statistics, (5) display the values satisfying the standard on the map, (6) visualize the geological structure on the map.

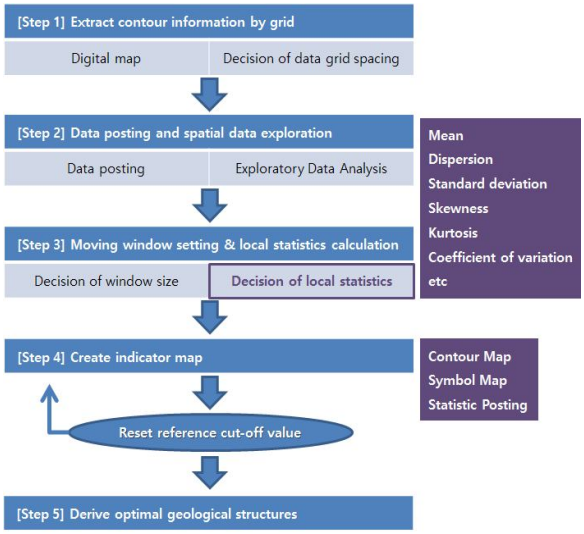


**Fig. 2 Elicitation procedures of spatial statistics.**

The important elements in this study include optimal size of moving window, kinds of optimal spatial statistics and determination of optimal percentile standard. To determine such optimal elements, a numerous simulations were implemented.

Eventually, user program based on R was developed using optimal analysis algorithm. R is the free commercial software which has been mostly commonly used, among many statistical analysis tools

worldwide.

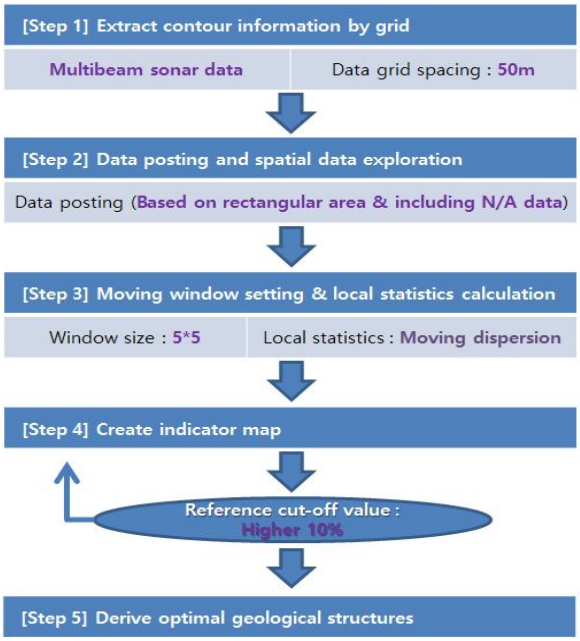


**Fig. 3 Procedure of automatic geological lineament analysis.**

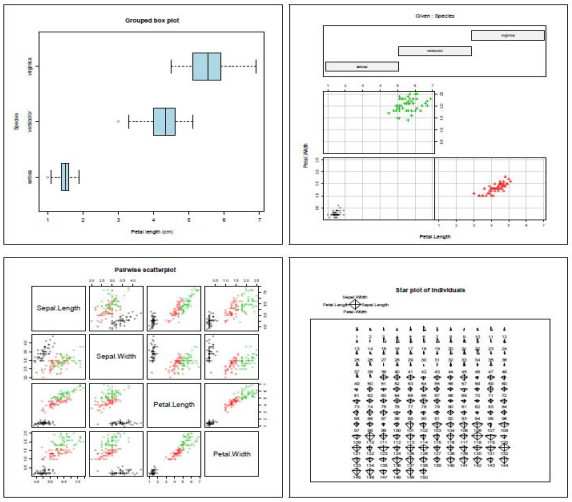


**Fig. 4 Example of exploratory data analysis using R.**

The user program was designed to identify the variations of various spatial statistics. It leads to easy analysis of geological structure depending on variation of spatial statistics by arranging to easily designate the type of spatial statistics and percentile standard.

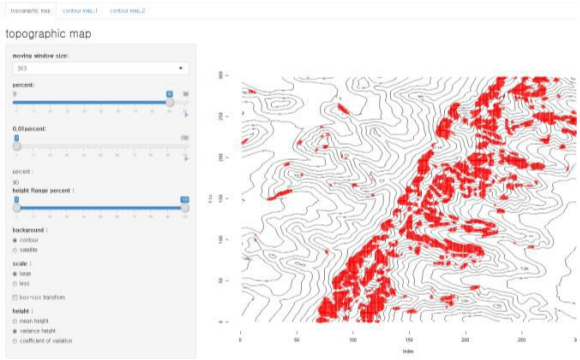


**Fig. 5 Geological structure analysis program using R.**

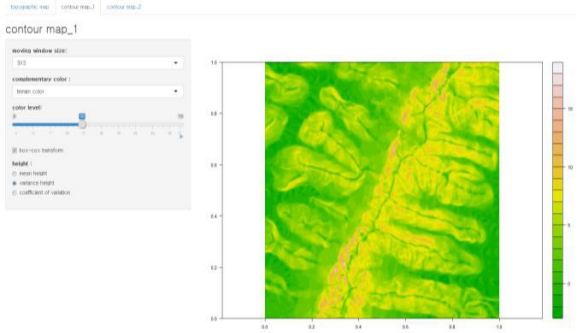


**Fig. 6 Geological structure analysis after box-cox conversion of moving dispersion statistics.**

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