Emergency Observation with SAR during Development of Disaster Mission Planning Support System

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1. Introduction

In a large-scale earthquake or similar event, slope failures may occur across a wide area, access roads to the stricken areas may be interrupted and landslide dams may be formed. For quick recovery of stricken areas and resident evacuation, it is necessary to grasp the situation of stricken areas at an early stage without being affected by the weather, etc.

For this reason, in order to eliminate, to the extent possible, the time when no information is available immediately after occurrence of a large-scale earthquake, etc., we have undertaken the study on the method of grasping affected areas quickly and widely by combining Synthetic Aperture Radar ("SAR") loaded in an artificial satellite that enables observation even at night or in bad weather and SAR loaded in an airplane with high mobility.

2. Content of study

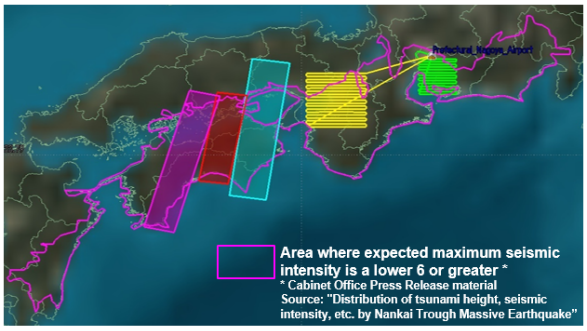
This study has developed a fundamental algorithm for formulating the fastest and most efficient observation operation plan by comprehensively analyzing operational conditions for "Sensor Platform" ("SP", i.e., artificial satellite and airplane), which is available in the event of a disaster, and environmental conditions (e.g., time, weather, available airport) in case of damage using the technique of Operations Research ("OR").[1)]

Based on this algorithm, we have also developed "Mission Planning Support System" (prototype) for computing the critical path of observation operation with "Microsoft Project" by managing various input conditions with Microsoft Excel and SP operation conditions with "Systems Tool Kit" (AGI).

As one of the examples for development, the Figure shows observation planning assuming the occurrence of Nankai Trough Massive Earthquake. This example provides the area that can be observed within 12 hours of the occurrence of a disaster under the conditions where maximum use of SP expected available is possible (assuming the occurrence of the disaster on December 22, 2015, at 1:00). Even these conditions, SP is not sufficient to observe all the areas where expected maximum seismic intensity is a lower 6 or greater. It was therefore found that increase of resources needs to be considered.

3. Conclusion

The algorithm and the planning support system developed by this study are just prototype version. In the future, in order to deduce more efficient observation routes, formulate efficient initial survey plans, and grasp necessary resources (SP etc.), we intend to upgrade the algorithm by utilizing the Theory of Search, which has been used in the OR field, for finding the object efficiently, etc. and to improve the planning support system for more practicability.



No.	Satellite / airplane	Observation beam	Observation start time (UTC)	Scheduled observation end time (UTC)	Legend
1	Satellite A	mode1	2015/12/22 2:50	2015/12/22 2:50	
2	Satellite B	mode2	2015/12/22 8:54	2015/12/22 8:55	
3	Satellite C	mode1	2015/12/22 9:37	2015/12/22 9:37	
4	Airplane A	mode2	2015/12/22 2:45	2015/12/22 6:43	
5	Airplane B	mode2	2015/12/22 2:17	2015/12/22 7:40	

Figure: Example for observation planning assuming the occurrence of Nankai Trough Massive Earthquake

[Reference]

1) IIDA Koji, "Science of Fighting in the Information Age, Revised ver. Introduction to Military OR," Sankeisha, 2004