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Designing GNSS-Based Early Warning System  
for Wide-Area Disasters in Multiple Countries

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## SUMMARY OF MASTER’S DISSERTATION

Student Identification Number	81333043	Name	Shota Iino
Title Designing GNSS-Based Early Warning System for Wide-Area Disasters in Multiple Countries			
Abstract <p>This thesis studies about designing GNSS-based Early Warning System for wide-area disasters in multiple countries.</p> <p>In 2004, massive tsunami after earthquake with magnitude 9.1 caused damages in more than 14 countries along Indian Ocean. After that, each country has been developing early warning systems. In 2012, big earthquake hit Indonesia's Banda Aceh. Early warnings in several countries in Indian Ocean didn't work properly. Early warning systems in many developing countries are still insufficient and large numbers of citizens cannot receive early warnings. In addition, information blanks may occur after big earthquakes because of severely damaged information network systems. GNSS-based early warning system is effective to provide early warnings in wide areas without depending on network infrastructure in each country. However sending messages through GNSS has limitation of data in a message and messages can be sent every a few seconds. When GNSS-based early warning system is used to send messages in the wide-areas, there are some issues to solve. One of the problems is that it is not possible to send messages to users in all areas once.</p> <p>Developing GNSS-based early warning system will contribute to save lives by delivering early warnings to users in the areas where network infrastructure is insufficient. Prototype with the scenario of Indian Ocean Tsunami with Quazi Zenith Satellite System (QZSS) was developed for sending early warnings to users in 13 countries across Indian Ocean. The message formats to distribute early warnings to users in wide-areas as many as possible and distribution schedules to send early warnings to users in the areas in right orders were designed within the limitations. Experiments to receive messages in evacuation routes in Indonesia and Thailand and simulations with the designed schedules and messages were performed for verification.</p> <p>To realize this system, more study with several scenarios and discussion with stakeholders in several countries were required.</p>			

Key Word (5 words)

GNSS, Early warning systems, disaster prevention information, Wide-area disaster, Multiple countries