

論文 / 著書情報
Article / Book Information

論題(和文)	
Title(English)	Development of tsunami database in Thailand through supercomputing research collaboration
著者(和文)	ピパットポンサー ティラポン, 青木 尊之
Authors(English)	T. Pipatpongsa, A. Ruangrassamee, Veera Muangsin, T. Aoki
出典(和文)	第20回国際開発学会全国大会報告論文集, , , pp. 168-171
Citation(English)	The Proceedings of the 20th Annual Conference, the Japan Society for International Development, , , pp. 168-171
発行日 / Pub. date	2009, 11
Note	初出は国際開発学会全国大会報告論文集学会誌である

Development of Tsunami Database in Thailand Through Supercomputing Research Collaboration

○Pipatpongsa, Thirapong *
Muangsin, Veera **

Ruangrassamee, Anat **
Aoki, Takayuki *

* Tokyo Institute of Technology

** Chulalongkorn University

<Abstract> The collaboration on large-scale computation of tsunami simulation between Chulalongkorn University of Thailand and Tokyo Institute of Technology was realized by the continuing efforts from both sides to pioneer the first case of international research collaboration using the supercomputer of Tokyo Institute of Technology. This study explains the background of the collaboration, procedures to facilitate computing resources, outcome in the research stage as well as real application of database. It is expected that the impact of collaboration would essentially contribute to Thailand and neighboring region on tsunami disaster preventive measures.

<keywords> Tsunami simulation, Grid supercomputer, International collaboration

1. Introduction

After the operation of TSUBAME by Global Scientific Information and Computing Center (GSIC) of Tokyo Institute of Technology (Tokyo Tech), the highest performance supercomputer in Asia (see Fig.1), the feasible issue of international research collaboration using TSUBAME has been considered to provide the excellent ground of knowledge-sharing and benefit to international community. The collaboration on large-scale computation of tsunami simulation with Chulalongkorn University (CU) of Thailand was realized by the continuing efforts from both sides to pioneer the first case of international research collaboration in which external users outside Japan are allowed to access Tokyo Tech's computing resources. The agreement for setting up research collaboration was concluded under research theme "Simulation of Tsunamis Generated by Earthquakes using Parallel Computing Technique". In the application stage, the developed programs were entirely run on Thai Grid, National Grid computing of Thailand, to provide a series of pre-computed tsunami database for Thailand National Disaster Warning Center. This study explains the background of the collaboration between both universities as well as addressing procedures to facilitate computing resources in the research stage. It is expected this initiation can provide some important basis which can bridge the gap of supercomputing resources to international research collaborations.

2. Scope of Research Collaboration

The research project aims to develop pre-computed tsunami database based on high-performance computing using parallel computing techniques. It is evident that tsunami early warning needs to be done in a timely and accurate manner in order to reduce losses to human lives in coastal areas at risk. Pre-computed tsunami database has been accepted as an effective way to report tsunami

height and arrival time for issuing tsunami warning. In this research, a series of tsunami simulation was conducted for 1000 possible focal mechanisms of earthquake focused on Andaman Sea and South China Sea. The wave height and arrival time was computed along coastal zones of Thailand and neighboring regions. Since the computation involves several computational cases and sub-regions, the parallel program was developed to effectively shorten computation time. The outcome from this study was used as a reference in a proposal applied to disaster warning projects of Thai government. With a support of Thai government, application of database is brought into practice by integrating to the system of the National Disaster Warning Center of Thailand.

3. Background of Research

Japan has been advanced in technology relating to earthquakes and tsunamis. One of the most well-known accomplishments is the tsunami model and computer program developed by the research team at Tohoku University. The program TUNAMI (Tohoku University's Numerical Analysis Method for Investigation of tsunamis) under TIME Project of UNESCO is seen as a great contribution of Japan to the international society by providing the tools for tsunami simulation which can be used to strengthen countermeasures against tsunamis disaster.



Fig.1: Tokyo Institute of Technology's TSUBAME operated by GSIC



Fig. 2: Devastation of the Indian Ocean tsunami (source: Thai TV channel 7)

Disaster caused by tsunamis has drawn awareness in Thailand since the devastation of Indian Ocean tsunami occurred in December 26, 2004 (See Fig.2). It is reported that the tsunami was generated by Mw 9.0+ earthquake near the shore of Sumatra. This deadly tsunami caused loss of human lives and damage to communities as well as infrastructure along the coastline. Many investigations and researches have been actively carried out to the affected regions. Despite Thai government has established the National Disaster Warning Center (NDWC) in 2005, there is few expert and local researches to feed knowledge about tsunamis. Because the simulation of tsunamis triggered by earthquake can be used to evaluate the effect of tidal wave, therefore, Faculty of Engineering, Chulalongkorn University of Thailand has started the research project to evaluate the effect of tsunamis in the gulf of Thailand and Andaman Sea using the modified program of TUNAMI.

In analyses, seismic data were collected from the measured data provided by international/local organizations as well as published sources. A range of bathymetric data sets is available from the General Bathymetric Chart of the Oceans (GEBCO) for the Andaman Sea and the South China Sea. In according to empirical formula proposed by various empirical models, estimation of vertical sea-bottom deformation due to earthquake can be estimated.

4. Review of International Collaboration

This project requires supercomputing facilities which is seen to be insufficiently available in Thailand. Therefore, the collaborative research on high-performance tsunami simulation based on parallel computing techniques using small-scale computation was undertaken between CU and Tokyo Tech. The framework for research collaborators who are external users of TSUBAME was achieved. MOU tied between the Faculty of Engineering of CU and GSIC of Tokyo Tech in collaborating joint researches has been officially made to facilitate the collaboration in June 2007. The computer program developed for PC cluster of CU is subject to tune up and test on TSUBAME for investigating a high performance of TSUBAME and for evaluating the efficiency of parallel computing in large-scale computation. Moreover, to cover scope of collaboration and allocation of resources, the particular agreement with GSIC was concluded in November 2007 as the pioneered collaboration under research theme “Simulation of Tsunamis Generated by Earthquakes using Parallel Computing Technique”. Details of research implementation, researcher data, right in works, dispute and revision, international issues and collaborative period were clarified. Article on international issues ensure that results will not be used for the purpose of weapon development by the third party. Contract of Collaborative Research Agreement with the industry liaison office of Tokyo Tech was signed in June 2008 to manage payment from CU to Tokyo Tech for the expense caused by using TSUBAME.

Continuing efforts of both sides has been spent for more than one year to realize the collaboration. Finally, the approval from the committee of GSIC was obtained to issue TSUBAME accounts accessible from Thailand to CU collaborators. The accounts provided have to renew and consider year by year. Record of meetings and dialogues and consent documents are listed in Table 1 and Table 2 respectively.

Table 1: Record of meetings and dialogues

Meetings	Date & Venue
Technical visit for TSUBAME from CU	2006/7/19 Tokyo Tech
Proposal of collaborative research using TSUBMAE	2006/10/25 Tokyo Tech
Discussion on possibilities of research collaboration	2006/11/29 CU
Analysis of Tsunamis using parallel computing techniques	2007/3/2 CU
Discussion on set-up of research collaboration	2007/3/6 Tokyo Tech
Discussion on the draft of MOU and tuning techniques	2007/4/4 CU
Parallel computing techniques	2007/9/13 CU

Table 2: Consent documents between both sides

Consent documents	Period
Memorandum of Understanding (GSIC-CU)	From: 2007/6/20 To: 2012/6/19
Agreement for International Research Collaboration using TSUBAME	From:2007/11/16 To: 2008/3/31
Renewal of Agreement for International Research Collaboration using TSUBAME	From: 2008/4/1 To: 2009/3/31
Contract of Collaborative Research Agreement	From: 2008/6/16 To: 2009/6/15
Renewal of Agreement for International Research Collaboration using TSUBAME	From: 2009/3/17 To: 2010/3/31

5. Results of Collaboration

Experimental analyses of the modified program TUNAMI using MPI library for managing parallel tasks and communication was undertaken by varying number of processor up to 256 CPUs on TSUBAME (see Fig.3). The model was verified by comparing results with the observed data in the December 26, 2004 event (see Fig.4). For massive computation, a series of tsunami simulation for several cases and sub-regions in coastal zones was computed thru Thai Grid, National Grid computing of Thailand. Tsunami database of tsunami amplitudes and arrival time was developed and collected to database system. This database can provide tsunami prediction before arrival when earthquake occurs. Web portal system is used to manage the database. An event close to an actual one could be searched and displayed. An automatic bulletin is developed for dissemination of warning information. Fig.5 and Fig. 6 show sample pages of the web portal system.

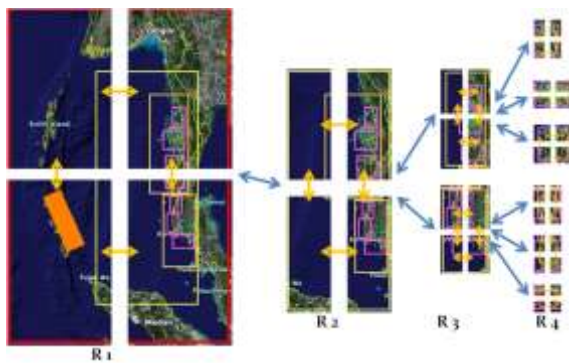


Fig. 3: Sub-domain under parallel schemes

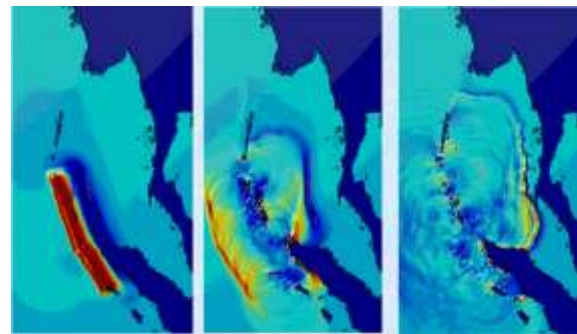


Fig. 4: Tsunami occurred in Andaman Sea

Fig. 5: Search page in web portal system

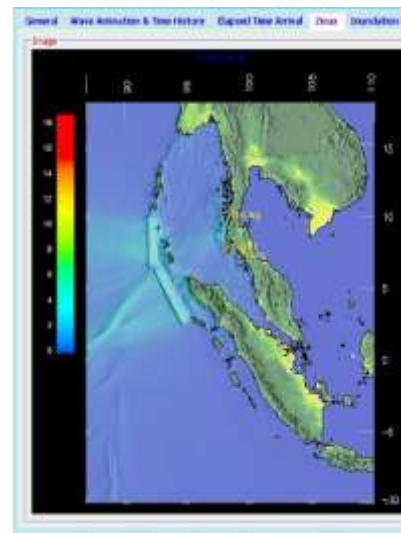


Fig. 6: Tsunami amplitude based on database

6. Conclusions

The international research collaboration using supercomputer between GSIC of Tokyo Tech and Dept. Engineering of CU was introduced in summary. It is expected that the impact of collaboration would essentially contribute to Thailand on disaster prevention.

References: Imamura, F., et al. (2006), Tsunami modeling Manual, 72p. Aphimaeteethomrong, P. & Muangsin, V. (2008), SNPD in Grid eXtreme Seminar, 694-699. Ruangrassamee, A. & Saelem, N. (2007), in The 4th International Conference on Urban Earthquake Engineering, 447-452.