

Title	疎結合分散環境における耐故障性と適応性を実現するソフトウェアの構成に関する研究
Author(s)	豊島, 真澄
Citation	
Issue Date	2001-06
Type	Thesis or Dissertation
Text version	author
URL	http://hdl.handle.net/10119/927
Rights	
Description	Supervisor:片山 卓也, 情報科学研究科, 博士

Design and Implementation of Fault Tolerant Software on Loosely Coupled Distributed Systems

Masumi Toyoshima

School of Information Science,
Japan Advanced Institute of Science and Technology

June 2001

Abstract

This thesis presents a task allocation method to implement fault tolerant software using functional programming paradigm. The design and implementation using group communication system is also discussed in order to build the runtime system on loosely coupled distributed environment.

Recently, many COTS computers are connected using LAN or WAN and there arise several projects which use the computation power of these inexpensive computation resources. In these loosely coupled distributed environment, there exists many components build up single system, there are different class of performance of computers, and the communication links may be sometimes down. In order to run large applications including long running scientific computation on such environment, it is important for such systems to be fault tolerance, the characteristics of a system to tolerate some fault and continue running in an acceptable level.

Many research work has been done in this area since 1970s and there exists some basic techniques to implement fault tolerance. However, most of these techniques are based on imperative programming paradigm. Though it is easy to understand its operational semantics using imperative programming paradigm, programmers have to consider many complication: detecting the fault, checkpointing system state and recovering using them to correct states, etc.

In order to avoid these difficulties, APR replication technique which is based on functional programming paradigm is introduced in 1998. The hole development, from the model of computation through implementation is introduced in APR approach. APR provides not only fault tolerance but it also shortens the time to complete computation. It is only needed for programmers to describe application program in functional manner in order to gain the above benefits.

Though the scheduling algorithm of functions in APR is introduced, the resource allocation method nor details of design and implementation including communication in loosely coupled distributed environment are still not defined.

This theses starts with the formalization of APR task scheduling algorithm. Then the *RAFT* resource management system is introduced in order to manage computation resources and allocate tasks to the resources. *RAFT* divides APR functions to more fine-grained tasks called *RAFT process* and distributes these processes to the computation resources existing on network. The recovery process in *RAFT* is also defined so as to minimize the recovery time when failures occur.

The design and implementation using group communication is also introduced in this thesis with its cost analysis. These works show the effectiveness and characteristics of the fault tolerant system which based on functional programming paradigm.

keywords : fault tolerant software, loosely coupled distributed systems, parallel computation, functional programming, resource allocation