

João Alfredo P. de Magalhães

## **Recovery Oriented Software**

**TESE DE DOUTORADO**

**DEPARTAMENTO DE INFORMÁTICA**

Postgraduate Program in Informatics

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PONTIFÍCIA UNIVERSIDADE CATÓLICA  
DO RIO DE JANEIRO



**João Alfredo P. de Magalhães**

**Recovery Oriented Software**

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Thesis presented to the Postgraduate Program in Informatics of the Departamento de Informática, PUC-Rio, as partial fulfillment of the requirements for the degree of Doutor em Informática.

Advisor: Arndt von Staa

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## Resumo

Pinto de Magalhães, João Alfredo; Staa, Arndt von. **Software Orientado à Recuperação**. Rio de Janeiro, 2009. 104p. Tese de Doutorado - Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Software orientado à recuperação é construído com a perspectiva que falhas de hardware e software bem como erros de operação são fatos com os quais se deve conviver, pois são problemas que não podem ser resolvidos no desenvolvimento de aplicações reais e complexas. Consequentemente, qualquer software sempre terá uma chance diferente de zero de falhar. Algumas dessas falhas podem ser causadas por defeitos que podem ser removidos ou encapsulados. Uma questão chave é aumentar a detectabilidade de erros, ou em outras palavras, aumentar a auto-consciência comportamental de um software. Nesse trabalho, apresentamos os resultados da aplicação sistemática de técnicas conhecidas (design by contract, self-checking software, componentes de software, software depurável, design for testability, mock components e padrões) com o objetivo de criar software orientado à recuperação. Através da medição de cinco aplicações reais de tempo real, analisamos os efeitos da adoção dessas técnicas. Em particular, observamos o balanceamento do esforço gasto em diferentes estágios do desenvolvimento e exploramos o conceito de “redundância de raciocínio” que, além de prover uma maior detectabilidade de erros e depurabilidade, também leva ao aumento da qualidade por construção. Os resultados foram encorajadores por terem sido sistematicamente melhores do que aqueles reportados pela literatura e obtidos a um custo acessível.

## Palavras-chave

Engenharia de software; software depurável; fidedignidade; corretude por construção.



## Abstract

Pinto de Magalhães, João Alfredo; Staa, Arndt von (Advisor). **Recovery Oriented Software**. Rio de Janeiro, 2009. 104p. DSc. Thesis - Departamento de Informática, Pontifícia Universidade Católica do Rio de Janeiro.

Recovery oriented software is built with the perspective that hardware or software failures as well as operation mistakes are facts to be coped with, since they are problems that cannot be fully solved while developing real complex applications. Consequently, any software will always have a non-zero chance of failure. Some of these failures may be caused by defects that could be removed or encapsulated. A key issue is to increase the detectability of errors, in other words, increase the self-awareness of the software's behavior. In this work, we present the results of systematically applying already well known techniques (design by contract, self-checking software, software components, debuggable software, design for testability, mock components and patterns) with the intent of creating recovery oriented software. Measuring the development of five different real-time and real world applications, we analyzed the effects of the adoption of these techniques. In particular we observed the balancing of the effort spent in different development stages and explore the "redundancy of reasoning" concept that, as well as providing a higher detectability and debuggability, also leads to enhancing quality-by-construction. The results were encouraging since they were systematically better than those reported in the literature and were achieved at a feasible cost

## Keywords

Software engineering; debuggable software; reliability; correctness by construction.

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