University of Zurich[UZH]

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Dynamic Distributed Constraint Optimization

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Acknowledgements

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Zusammenfassung

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Abstract

This thesis is about understanding the performance and behaviour of various existing distributed constraint optimization algorithm approaches (complete, local-iterative message-passing, local-iterative best-response) in context of a dynamic environment, e.g changing constraints or other parameters. The use case for this analysis will be the scheduling problem, which needs to be mapped to the algorithms accordingly. The goals are adding a general module to the existing framework for dcops, which can simulate dynamic environments / parameter changes in various ways, mapping existing dcop algorithms to signal collect and evaluate their performance. An additional goal would be to suggest or test a blended algorithm with local-iterative characteristics that handles change better by applying techniques from dynamic approaches which are not local-iterative. The benchmarking is done with respect to change (resilience to change / stability, amount of variable value changes necessary to bounce back), solution quality (how fast can the algorithms reach a defined quality), Time-to-Convergence (how long does it take to converge).

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Introduction 2

The goal of this thesis is explore dynamic distributed constraint optimization. Constraint optimization itself is well-researched field and even distributed constraint optimization has been under research. The aspect of having a dynamic environment and dynamic meaning changing constraints is very under-developed and underinvestigated.

The thesis tries to bring further what previously has been achieved in several bachelor and master thesis. The main goal is to show the capabilities of the signal-collect framework and the performance in distributed environments. Important is also mapping of the chosen Meeting Scheduling Problem and And how algorithms like the Max-Sum algorithm can be extended to better perform in dynamic environments. All those implementations shall be tested in benchmarking situations.

First I will give an overview about various definitions and aspects of constraint optimization in general, as well as the aspects of distributed and dynamic environments. I am also going to give an overview about different approaches of algorithms to solve constraint optimization problems and their advantages and disadvantages in various contexts. The I will choose appropriate algorithms for the experiments and comparisons and map them to the meeting scheduling problem. I also will design an attempt of introducing dynamic environments that fits into the given framework provided by DDIS. Then I will describe the implemenation details of the algorithms and the testbed, as well as the dynamic environment modelling. After that I will conduct experiments in various testsets, various algorithms, various setups and analyze the limitations of existing algorithms to the problem in dynamic environments, as well as options to optimize defined benchmarks like bounce-back time after amount of change, time to reach certain quality, etc.

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Background

2.1 Constraint Optimization

2.2 Distributed Constraint Optimization

2.3 Complete and Incomplete

2.4 Local-Iterative Message Passing

2.5 Local-Iterative Best Response

2.6 Dynamic

2.7 Scheduling Problem

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Related Work 10

- epfl - dynamic erweiterung
  - klassische papers -

3.1 Constraint Optimization Approaches

- Constraint Optimization Basics - Distributed Constraint Optimization - Local Iterative Approaches - Best-Response Approaches - Complete Approaches - Incomplete Approaches - Distributed Approaches - Dynamic Approaches - Distributed and Dynamic Approaches

3.2 Use Cases for Constraint Optimization

- Applications of those approaches

3.3 Constraint Optimization Benchmarking

- Benchmarking

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Design 10

4.1 Mapping Algorithms to Signal/Collect

4.2 Scheduling Problem Definition and General Mapping

4.3 Change Module as Framework Extension

4.4 DCOP Algorithms

4.4.1 Complete - DCOP

- Distributed, Not Dynamic, Complete -¿ Show what is wrong with this approach regarding dynamic

4.4.2 Dynamic, Complete - RSDPOP

4.4.3 Not local-iterative - SBDO

- Distributed, Dynamic, Not-Local-Iterative -¿ Show what is wrong with this approach regarding dynamic

4.4.4 Best-Respone - Maximum Gain Messaging

- Distributed, Not Dynamic, Not-Local-Iterative -¿ Show what is wrong with this approach regarding dynamic

4.4.5 Best Response - DSA

4.4.6 Local Iterative - MaxSum

-¿ Local Iterative -¿ Good fit for dynamic -¿ Better than the above -¿ Fewer information disclosure

4.4.7 Best Response, Local Search - Population-Based Iterated Local Search

Why Population-Based for Dynamic Problems

-¿ Local Iterative -¿ Provides multiple solutions to a problem -¿ Good fit for dynamic -¿ check which solution is best for changed circumstances -¿ Good fit to stop getting stuck in local optima -¿ Better than the above

Implementation in Signal/Collect

4.5 Testbed

4.5.1 Dataset

4.5.2 Evaluation

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Implementation 10

5.1 Change Module for Framework

5.2 Testbed

- Datasets - Storage of Results - Evaluation

5.3 DCOP in Signal/Collect

5.4 SBDO in Signal/Collect

5.5 Best-Response in Signal/Collect

5.6 DSA in Signal/Collect

5.7 Max-Sum in Signal/Collect

5.8 Population-based in Signal/Collect

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Experiments 15

6.1 Experiment Design

6.2 Testing Environment

6.3 Results

6.3.1 Resilience to dynamic Environments

- Mainly to proof flaws of the other approaches when it comes to dynamic

6.3.2 Solution Quality

- Static / Dynamic - Mainly to proof the ability of new approaches to keep stable and reach certain goals

6.3.3 Time to Convergence

6.3.4 Scalability

- Number of Messages - Number of Agents - Mainly to show that local-iterative scales well because the number of messages is low

6.3.5 Hardware Requirements

- Additional layer of argumentation and analysis

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Limitations 2

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Future Work 1

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Conclusions 3

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References

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