

**Case-based Adaptation Applied to Hydraulic
Circuit Design**

by

Vong Chi Man

Master of Science in Software Engineering

2000



**Faculty of Science and Technology
University of Macau**

07 AUG 2000

TABLE OF CONTENTS

LIST OF FIGURES	iii
LIST OF TABLES.....	iv
LIST OF ABBREVIATIONS.....	v
CHAPTER 1: Case-based Reasoning	1
1.1 Brief Introduction to CBR	1
1.2 Adaptation Methods in CBR.....	4
1.2.1 Substitutional Adaptation	4
1.2.2 Transformational Adaptation.....	5
1.2.3 Derivational Replay	6
CHAPTER 2: Literature Review	8
2.1 Systems with No Adaptation	8
2.2 Systems with Substitution.....	9
2.3 Systems with Transformation	9
2.4 Systems with Derivational Replay.....	10
2.5 Systems with Adaptation-Guided Retrieval.....	11
2.6 Shortcoming of Existing CBR Systems.....	12
2.7 Objective of The Research.....	12
CHAPTER 3: Case-based Adaptation	13
3.1 A New Adaptation Method -- Cased-based Adaptation	13
3.2 Adaptation Operators.....	14
3.2.1 A Formal Definition.....	15
3.2.2 Definitions of Cases and Adaptation Knowledge.....	16
3.2.3 Construction of Adaptation Cases	17
3.3 Application Domain -- Hydraulic Circuit Design.....	18
3.3.1 Problems in Existing Expert Systems for Hydraulic Circuit Design.....	20
3.3.2 Advantages of Applying CBR	22
3.3.3 Adaptation in Hydraulic Circuit Design	23
CHAPTER 4: System Implementation	26

4.1 Knowledge Representation	26
4.1.1 Knowledge Representation of Primary Subcircuit	26
4.1.2 Knowledge Representation of Power Subcircuit	26
4.2 Procedures Performed by the Design System	28
4.3 Knowledge Reuse	30
4.4 Learning Phase of the Design System	32
4.5 Supplement to the Retrieval Process of Adaptation case.....	33
CHAPTER 5: Results and Discussion	36
5.1 Example of Manual Adaptation	36
5.2 Example of Feature Learning.....	42
5.3 Example of Case-Based Adaptation	44
5.3.1 Exact Matching in Adaptation Capability	44
5.3.2 Partial Matching in Adaptation Capability and Adaptable	46
5.3.3 Partial Matching in Adaptation Capability but Not Adaptable.....	47
CHAPTER 6: Conclusions	49
6.1 Contribution in AI Perspective	49
6.1.1 Evolving Knowledge Representation Using DBMS.....	49
6.1.2 Case-Based Adaptation.....	50
6.2 Contribution in Hydraulic Engineering Perspective	50
6.2.1 Adaptation Knowledge Acquisition.....	51
6.2.2 Reduction in Design Lead Time	51
CHAPTER 7: Future Direction.....	52
7.1 Further Research Synthesis of Multiple Adaptation Cases.....	52
7.2 Enhancement in Graphics and Automation	53
BIBLIOGRAPHY	55