

ผลของขนาดหน้าต่างต่อการปรากฏสีของแผ่นทดสอบภายใต้แสงสี



นางสาว พุฒพร ห้าวเจริญ

วิทยานิพนธ์นี้เป็นส่วนหนึ่งของการศึกษาตามหลักสูตรปริญญาวิทยาศาสตรมหาบัณฑิต
สาขาวิชาเทคโนโลยีทางภาพ ภาควิชาวิทยาศาสตร์ทางภาพถ่ายและเทคโนโลยีทางการพิมพ์
คณะวิทยาศาสตร์ จุฬาลงกรณ์มหาวิทยาลัย

ปีการศึกษา 2548

ISBN 974-17-5156-7

ลิขสิทธิ์ของจุฬาลงกรณ์มหาวิทยาลัย

T 22467506

EFFECTS OF WINDOW SIZES ON COLOR APPEARANCE OF TEST PATCHES
UNDER COLORED ILLUMINATION

Miss Pruthaporn Haocharoen

A Thesis Submitted in Partial Fulfillment of the Requirements
for the Degree of Master of Science Program in Imaging Technology
Department of Photographic Science and Printing Technology

Faculty of Science

Chulalongkorn University

Academic Year 2005

ISBN 974-17-5156-7

481938


Thesis Title EFFECTS OF WINDOW SIZES ON COLOR APPEARANCE OF
TEST PATCHES UNDER COLORED ILLUMINATION
By Miss Pruthaporn Haocharoen
Field of study Imaging Technology
Thesis Advisor Associate Professor Pontawee Punggrassamee, M.S.
Thesis Co-advisor Professor Mitsuo Ikeda, Ph.D.

Accepted by the Faculty of Science, Chulalongkorn University in Partial
Fulfillment of the Requirements for the Master's Degree

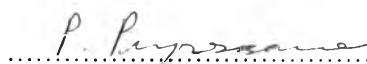


..... Dean of the Faculty of Science
(Professor Piamsak Menasveta, Ph.D.)

THESIS COMMITTEE



..... Chairman
(Associate Professor Aran Hanseubsai, Ph.D.)



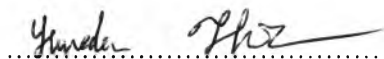
..... Thesis Advisor
(Associate Professor Pontawee Punggrassamee, M.S.)



..... Thesis Co-advisor
(Professor Mitsuo Ikeda, Ph.D.)



..... Member
(Pichayada Katemake, Ph.D.)



..... Member
(Yuwadee Thiangthangtum, Ph.D.)

พุดมพร หัวเจริญ : ผลของขนาดหน้าต่างต่อการปรากฏสีของแผ่นทดสอบภายใต้แสงสี.
(EFFECTS OF WINDOW SIZES ON COLOR APPEARANCE OF TEST PATCHES
UNDER COLORED ILLUMINATION) อ. ที่ปรึกษา : รศ. พรทวี พึ่งรัศมี, อ. ที่ปรึกษาร่วม :
ศ. ดร. มิตสุโอะ อิเคดะ 111 หน้า. ISBN 974-17-5156-7.

งานวิจัยนี้ได้อาศัยแนวคิดการจดจำสภาพความสว่างของพื้นที่ที่มองเห็น (Recognized Visual Space of Illumination; RVSI) มาใช้เพื่อศึกษาถึงผลของขนาดหน้าต่างต่อการปรากฏสีของแผ่นทดสอบภายใต้แสงสี วิธีการทดลองทำโดยให้ผู้สังเกตประเมินการปรากฏสีของแผ่นทดสอบด้วยวิธีการบอกส่วนประกอบสีพื้นฐาน (elementary color naming method) โดยการมองจากห้องผู้สังเกต ซึ่งได้รับความสว่างจากหลอดฟลูออเรสเซนต์ชนิดเดย์ไลท์ ผ่านหน้าต่างขนาดแตกต่างกันห้าขนาดไปยังแผ่นทดสอบ ซึ่งวางอยู่ในห้องทดสอบ และได้รับความสว่างจากแสงสีหนึ่งในแปดแสงสีที่ใช้ในการทดลอง คือ แสงสีแดงที่มีความอิ่มตัวแตกต่างกันสี่ระดับ และแสงสีเหลืองที่มีความอิ่มตัวแตกต่างกันสี่ระดับ ผู้สังเกตที่ร่วมทำการทดลองมีทั้งหมดห้าคน ผลการทดลองพบว่า เมื่อมองแผ่นทดสอบผ่านหน้าต่างขนาดเล็กที่สามารถมองเห็นเฉพาะแผ่นทดสอบภายในช่องหน้าต่าง การปรากฏสีของแผ่นทดสอบจะอมไปทางสีของแสงที่ให้ ความสว่างแก่ห้องทดสอบในขณะนั้น แต่เมื่อขนาดหน้าต่างใหญ่ขึ้นจนผู้สังเกตสามารถมองเห็นวัตถุอื่น นอกเหนือจากแผ่นทดสอบภายในช่องหน้าต่าง การปรากฏสีของแผ่นทดสอบจะกลับไปคล้ายกับสีเดิมของแผ่นทดสอบนั้น ยกเว้นในกรณีที่แผ่นทดสอบได้รับความสว่างจากแสงสีที่มีความอิ่มตัวสีสูงสุด การปรากฏสีของแผ่นทดสอบยังคงไม่คล้ายกับสีเดิมถึงแม้จะมองผ่านหน้าต่างขนาดใหญ่ที่สุดแล้วก็ตาม แสดงให้เห็นว่าความคงที่ของสี (color constancy) ไม่เกิดขึ้นในกรณีที่ห้องทดสอบได้รับความสว่างจากแสงสีที่มีความอิ่มตัวสูง

ภาควิชาวิทยาศาสตร์ทางภาพถ่าย และเทคโนโลยีทางการพิมพ์ ลายมือชื่อนิสิต..... พ.ช. ๒๕๔๘..... พ.ว.เจ.เจ.ณ.....
สาขาวิชาเทคโนโลยีทางภาพ.....ลายมือชื่ออาจารย์ที่ปรึกษา.....
ปีการศึกษา 2548.....ลายมือชื่ออาจารย์ที่ปรึกษาร่วม.....

4772391023 : MAJOR IMAGING TECHNOLOGY

KEY WORD: COLOR CONSTANCY / SPACE RECOGNITION / ILLUMINATION / COLOR APPEARANCE /
RECOGNIZED VISUAL SPACE OF ILLUMINATION

PRUTHAPORN HACHAROEN : EFFECTS OF WINDOW SIZES ON COLOR
APPEARANCE OF TEST PATCHES UNDER COLORED ILLUMINATION.
THESIS ADVISOR : ASSOC. PROF. PONTAWEE PUNGRASSAMEE, M.S.,
THESIS COADVISOR : PROF. MITSUO IKEDA, Ph.D., 111 pp. ISBN 974-17-5156-7.

This experiment is based on the concept of Recognized Visual Space of Illumination (RVSI) and aims to investigate the effect of window size on the color appearance of the test patch under colored illumination. The color appearance was judged by elementary color naming for the test patch which was placed in a test room illuminated by one of eight colored illuminations, four red illuminations of different saturation and four yellow illuminations of different saturation. Subject observed the test patch from a subject room illuminated by fluorescent lamps of daylight type through window of various sizes. Five subjects participated in the experiment. We found that when the window was small so that only the test patch was seen within the window the color appearance of the test patch shifted into the direction of color of illumination, but when the window size was enlarged so that the subject could see some objects in the test room the color appearance returned to its original color in most cases. However when we used the test room illumination of the maximum saturation, the color appearance of test patches did not returned to their original color implying that the color constancy fail for this extreme room illumination.

Department of Photographic Science and Printing Technology Student's signature.....*P. Pruthaporn*.....
Field of study Imaging Technology.....Advisor's signature.....*P. Pongrassamee*.....
Academic year 2005.....Co-advisor's signature.....*Mitsuo Ikeda*.....

ACKNOWLEDGEMENTS

First of all, I wish to express my sincere appreciation to my advisor and my co-advisor, Assoc. Prof. Pontawee Pungrassamee, Prof. Dr. Mitsuo Ikeda of Ritsumeikan University, Japan, presently also Visiting Professor of Chulalongkorn University, and Assoc. Prof. Dr. Aran Hansuebsai, for their valuable suggestion and help throughout the course of the work; special thank to Prof. Dr. Mitsuo Ikeda for kindly making many helpful comments.

Thanks to Thailand-Japan Technology Transfer Project for supporting the equipment and apparatus.

I acknowledge all subjects, Assoc. Prof. Pontawee Pungrassamee, Mr. Dhamrongruchana Hoontrakul, Miss Jirata Jintanakan and Mr. Mana Wangkijjaroenusuk for their participation in the experiment.

I would like to thank the thesis committee, Assoc. Prof. Dr. Aran Hansuebsai, Assoc. Prof. Pontawee Pungrassamee, Prof. Dr. Mitsuo Ikeda, Dr. Pichayada Katemake and Dr. Yuwadee Thiangthangtum for their comments and suggestions.

Finally, I am very grateful to my parents, Mr. Krisda Haocharoen, Mrs. Yupar Haocharoen and my sister, Miss Kritaporn Haocharoen, who is a lecturer at Faculty of Architecture, Thammasat University, for their help, love and encouragement.

CONTENTS

	PAGE
ABSTRACT (IN THAI).....	iv
ABSTRACT (IN ENGLISH).....	v
ACKNOWLEDGEMENTS.....	vi
CONTENTS.....	vii
LIST OF TABLES.....	ix
LIST OF FIGURES.....	xiii
CHAPTER I : INTRODUCTION.....	1
1.1 Objective.....	2
1.2 Scope of the Thesis.....	2
1.3 Key Words.....	3
1.4 Content of the Thesis.....	3
CHAPTER II : THEORETICAL CONSIDERATION AND LITERATURE REVIEW.....	4
2.1 Theoretical Consideration.....	4
2.1.1 Lightness Constancy.....	5
2.1.2 Color Constancy.....	5
2.1.3 Recognized Visual Space of Illumination (RVSI).....	6
2.1.4 Color Appearance Mode.....	8
2.2 Literature Review.....	8
CHAPTER III : EXPERIMENT.....	11
3.1 Apparatus.....	11
3.2 Experimental Conditions.....	14
3.3 Subjects.....	17
3.4 Procedure.....	17
3.4.1 Methodology.....	17
3.4.1.1 Elementary Color Naming Method.....	17
3.4.2 Experiment.....	18
CHAPTER IV : RESULT.....	21
4.1 Results of control experiments.....	21

	PAGE
4.2 Results of main experiment.....	25
CHAPTER V : CONCLUSION AND DISCUSSION.....	50
REFERENCES.....	56
APPENDICES.....	57
APPENDIX A : Color appearance of illumination judged by 5 subjects.....	58
APPENDIX B : Original color appearance of test patches judged by 5 subjects	64
APPENDIX C : Color appearance of the test patches judged by 5 subjects..	70
VITA.....	111

LIST OF TABLES

Table	PAGE
A-1 Color appearance of colored illumination observed by subject PP.....	59
A-2 Color appearance of colored illumination observed by subject DH.....	60
A-3 Color appearance of colored illumination observed by subject JJ.....	61
A-4 Color appearance of colored illumination observed by subject PH.....	62
A-5 Color appearance of colored illumination observed by subject MW.....	63
B-1 Original color appearance of test patches observed by subject PP.....	65
B-2 Original color appearance of test patches observed by subject DH.....	66
B-3 Original color appearance of test patches observed by subject JJ.....	67
B-4 Original color appearance of test patches observed by subject PH.....	68
B-5 Original color appearance of test patches observed by subject MW.....	69
C-1 Color appearance of test patches under red illumination condition R5+W20 observed by subject PP.....	71
C-2 Color appearance of test patches under red illumination condition R12+W13 observed by subject PP.....	72
C-3 Color appearance of test patches under red illumination condition R19+W6 observed by subject PP.....	73
C-4 Color appearance of test patches under red illumination condition R25+W0 observed by subject PP.....	74
C-5 Color appearance of test patches under yellow illumination condition Y5+W20 observed by subject PP.....	75
C-6 Color appearance of test patches under yellow illumination condition Y12+W13 observed by subject PP.....	76
C-7 Color appearance of test patches under yellow illumination condition Y19+W6 observed by subject PP.....	77
C-8 Color appearance of test patches under yellow illumination condition Y25+W0 observed by subject PP.....	78
C-9 Color appearance of test patches under red illumination condition R5+W20 observed by subject DH.....	79

	PAGE
C-10	Color appearance of test patches under red illumination condition
	R12+W13 observed by subject DH..... 80
C-11	Color appearance of test patches under red illumination condition
	R19+W6 observed by subject DH..... 81
C-12	Color appearance of test patches under red illumination condition
	R25+W0 observed by subject DH..... 82
C-13	Color appearance of test patches under yellow illumination condition
	Y5+W20 observed by subject DH..... 83
C-14	Color appearance of test patches under yellow illumination condition
	Y12+W13 observed by subject DH..... 84
C-15	Color appearance of test patches under yellow illumination condition
	Y19+W6 observed by subject DH..... 85
C-16	Color appearance of test patches under yellow illumination condition
	Y25+W0 observed by subject DH..... 86
C-17	Color appearance of test patches under red illumination condition
	R5+W20 observed by subject JJ..... 87
C-18	Color appearance of test patches under red illumination condition
	R12+W13 observed by subject JJ..... 88
C-19	Color appearance of test patches under red illumination condition
	R19+W6 observed by subject JJ..... 89
C-20	Color appearance of test patches under red illumination condition
	R25+W0 observed by subject JJ..... 90
C-21	Color appearance of test patches under yellow illumination condition
	Y5+W20 observed by subject JJ..... 91
C-22	Color appearance of test patches under yellow illumination condition
	Y12+W13 observed by subject JJ..... 92
C-23	Color appearance of test patches under yellow illumination condition
	Y19+W6 observed by subject JJ..... 93

	PAGE	
C-24	Color appearance of test patches under yellow illumination condition Y25+W0 observed by subject JJ.....	94
C-25	Color appearance of test patches under red illumination condition R5+W20 observed by subject PH.....	95
C-26	Color appearance of test patches under red illumination condition R12+W13 observed by subject PH.....	96
C-27	Color appearance of test patches under red illumination condition R19+W6 observed by subject PH.....	97
C-28	Color appearance of test patches under red illumination condition R25+W0 observed by subject PH.....	98
C-29	Color appearance of test patches under yellow illumination condition Y5+W20 observed by subject PH.....	99
C-30	Color appearance of test patches under yellow illumination condition Y12+W13 observed by subject PH.....	100
C-31	Color appearance of test patches under yellow illumination condition Y19+W6 observed by subject PH.....	101
C-32	Color appearance of test patches under yellow illumination condition Y25+W0 observed by subject PH.....	102
C-33	Color appearance of test patches under red illumination condition R5+W20 observed by subject MW.....	103
C-34	Color appearance of test patches under red illumination condition R12+W13 observed by subject MW.....	104
C-35	Color appearance of test patches under red illumination condition R19+W6 observed by subject MW.....	105
C-36	Color appearance of test patches under red illumination condition R25+W0 observed by subject MW.....	106
C-37	Color appearance of test patches under yellow illumination condition Y5+W20 observed by subject MW.....	107

	PAGE
C-38 Color appearance of test patches under yellow illumination condition	
Y12+W13 observed by subject MW.....	108
C-39 Color appearance of test patches under yellow illumination condition	
Y19+W6 observed by subject MW.....	109
C-40 Color appearance of test patches under yellow illumination condition	
Y25+W0 observed by subject MW.....	110

LIST OF FIGURES

FIGURE	PAGE
2-1	8
Scheme of RVSI; FX, fundamental axis; RX, recognition axis; IX, illumination axis (a) daylight type illumination; (b) red illumination.....	
3-1	11
Scheme of the experimental booth.....	
3-2	12
Side view of an experimental booth.....	
3-3	13
The front wall of the subject room.....	
3-4	14
View of the test room.....	
3-5	15
The chromaticity coordinates of the eight colors of illumination and the daylight type illumination.....	
3-6a	16
The chromaticity coordinates of test patches under red illumination.....	
3-6b	16
The chromaticity coordinates of test patches under yellow illumination of different saturation.....	
3-7	18
The color appearance diagram to plot the result of the elementary color naming.....	
3-8	20
Color appearance diagram.....	
4-1a	23
Colors of four defined saturations of red illumination as judged for the test room.....	
4-1b	24
Colors of four defined saturations of yellow illumination as judged for the test room.....	
4-2	25
Original color as judged for the test patches.....	
4-3a	26
Data from the red illumination R5+W20 and green test patch 5G5/3 combination plotted for five sessions.....	
4-3b	27
Data from the yellow illumination Y12+W13 and blue test patch 5B5/3 combination plotted for five sessions.....	
4-4a	28
Data from the red illumination R5+W20 and green test patch 5G5/3 combination plotted for average.....	
4-4b	29
Data from the yellow illumination Y12+W13 and blue test patch 5B5/3 combination plotted for average.....	

	PAGE	
4-5	The chromaticity coordinates of five test patches measured under the test room illumination of red (R5+W20) and yellow (Y12+W13).....	31
4-6a	Results for condition R5+W20.....	33
4-6b	Results for condition R12+W13.....	34
4-6c	Results for condition R19+W6.....	35
4-6d	Results for condition R25+W0.....	36
4-7	Chromaticity coordinates of test patches are plotted on the CIE xy chromaticity diagram.....	37
4-8a	Results for condition Y5+W20.....	39
4-8b	Results for condition Y12+W13.....	40
4-8c	Results for condition Y19+W6.....	41
4-8d	Results for condition Y25+W0.....	42
4-9	Mean results for the red illumination and five test patches.....	44
4-10	Mean results for the yellow illumination and five test patches.....	45
4-11	Mean results for the red and yellow illumination and four test patches, only W5.....	46
4-12a	Change of color elements for different window size. The test patch-red illumination condition is shown at the upper of each section. Average of five subjects.....	48
4-12b	Change of color elements for different window size. The test patch-yellow illumination condition is shown at the upper of each section. Average of five subjects.....	49
5-1	1931 CIE chromaticity diagram with resemble lines of constant hue and saturation.....	52
5-2	Mean results for the red illumination and four test patches as seen through window of various sizes.....	54
5-3	Mean results for the yellow illumination and four test patches as seen through window of various sizes.....	55