

MASTER

Image quality

not just a matter of opinion : sharpness enhancement as a function of viewing distance and ambient illumination

Hoek, Roderick

Award date:
2006

[Link to publication](#)

Disclaimer

This document contains a student thesis (bachelor's or master's), as authored by a student at Eindhoven University of Technology. Student theses are made available in the TU/e repository upon obtaining the required degree. The grade received is not published on the document as presented in the repository. The required complexity or quality of research of student theses may vary by program, and the required minimum study period may vary in duration.

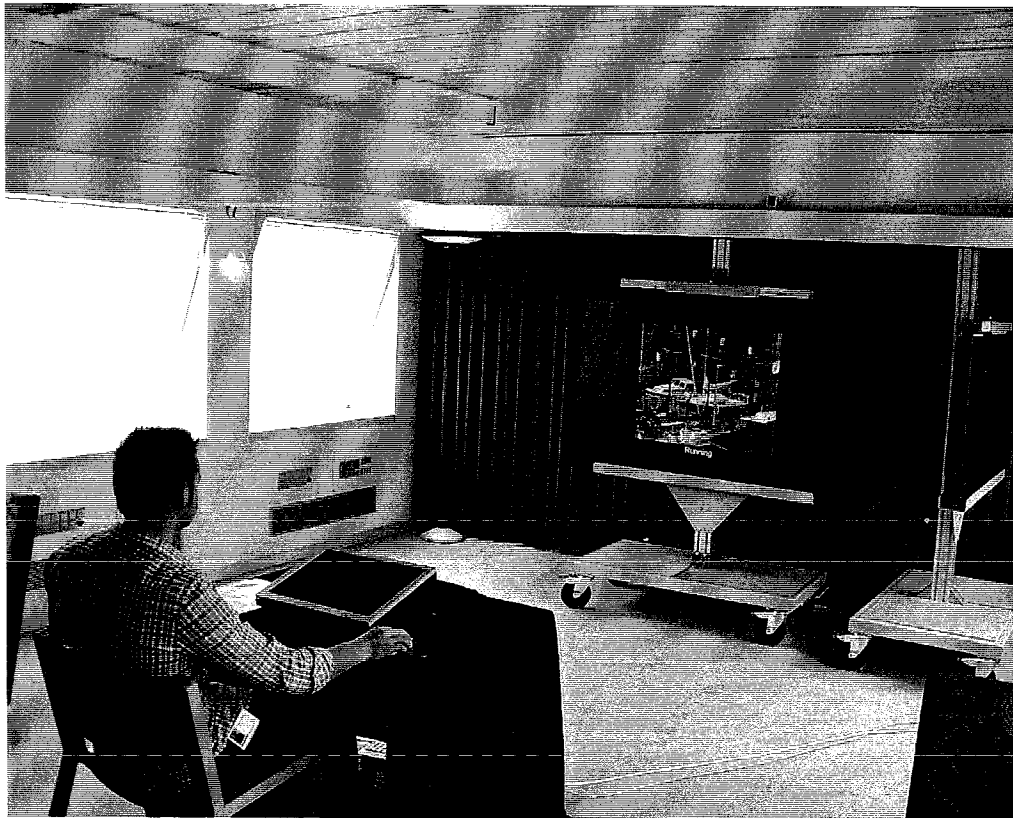
General rights

Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain

Image quality: Not just a matter of opinion

*Sharpness enhancement as a function
of viewing distance and ambient illumination*



Author:	Roderick Hoek
Student id:	0445655
First supervisor TU/e:	Wijnand IJsselsteijn
Second supervisor TU Delft:	Ingrid Heynderickx
Supervisors Bang and Olufsen:	Søren Bech
	Torben Dalgaard

Preface

This report is the end product of a seven month internship at Bang and Olufsen (B&O) in Denmark. The project involved viewing distance as a measure to adjust screen settings. During my internship I received support from several people to whom I want show my appreciation here.

First off I want to thank my girlfriend, Marieke, for the support she gave me while I was abroad and while writing this report in the Netherlands. Her encouragements have helped me to bring my education in Technology Innovation Sciences to a good ending.

Secondly I would like to thank B&O as a company for providing me with the opportunity to spend seven months in Struer to get a peak behind the screens of the world's most exclusive manufacturer of home entertainment systems. At B&O I would like to thank Søren Bech and Torben Dalgard for their guidance during and outside of our weekly meetings. And I would like to thank Per Bennetsen for his practical help in putting together my experiment in "his" Mediaroom.

I thank dr. Wijnand IJsselsteijn, my first guiding professor and prof. dr. Ingrid Heynderickx, my second guiding professor, for their feedback during and after the internship.

Last of all I want to thank others that attended the EyeRis meeting for their feedback on my preliminary statistics.

Roderick Hoek, Spring / Summer 2006

Abstract

Image quality depends on both the physical representation of an image as well as effects of the surroundings. To change the quality of the physical representation of an image, several methods are available; one of these methods focuses on the enhancement of image sharpness. The amount of sharpness enhancement is limited by the fact that enhancing sharpness too much can lead to images that appear unnatural. Therefore the method has an optimal setting which is determined based on an overall image quality impression

This research has focussed on retrieving the influence of surroundings on the preferred optimal setting. It was expected that people want more sharpness enhancement when ambient illumination and viewing distance are high. Results of an executed experiment support these expectations. Personal preference also turns out to be an important factor in determining peaking level.

Index

Preface.....	2
Abstract.....	3
Index	4
1. Introduction.....	6
1.1 Rationale for research	6
1.2 Scientific and practical relevance	7
1.3 Structure of this report	7
2 Theoretical background.....	8
2.1 Vision.....	8
2.1.1 The human eye.....	8
2.1.2 Rods and Cones.....	9
2.1.3 Visual acuity	10
2.1.4 Physiological limits to visual acuity	10
2.1.5 Linespread.....	11
2.1.6 The line spread function and the modular transfer function	11
2.1.7 The contrast sensitivity function.....	12
2.1.8 Adaptation to ambient light	12
2.1.9 Effects of light adaptation on visual acuity.....	14
2.2 Image quality	15
2.2.1 Introduction.....	15
2.2.2 Image quality in literature	15
2.2.3 Visual acuity and subjective image quality.....	16
2.2.4 The size constancy effect.....	17
2.3 Quality Limitations caused by technical standards.....	18
2.3.1 Analog television broadcast.....	18
2.3.2 Digital video broadcast	19
2.3.3 Non-broadcast sources	19
2.4 Control over image quality	21
2.4.1 Spatial resolution	21
2.4.2 Intensity range and screen controls.....	22
2.4.3 Image sharpness enhancement.....	23
2.5 Objective image quality vs. subjective image quality	24
2.5.1 Introduction.....	24
2.5.2 Viewing distance, angular resolution and field of view.....	24
2.5.3 Ambient light	25
2.5.4 Modelling image quality	25
2.6 Research question and hypotheses.....	26
3 Method	27
3.1 Introduction, type of research and justification	27
3.2 Experimental design.....	27
3.3 Stimuli.....	29
3.3.1 Images	29
3.3.2 Display screens	30
3.4 Experimental conditions	31
3.4.1 Angular resolution and field of view	31
3.4.2 Viewing distance.....	32
3.4.3 Ambient illumination	33

3.5	Participants.....	34
3.6	The experimental surroundings and user interface	34
3.6.1	The Mediaroom.....	34
3.6.2	User interface	35
3.6.3	Computer setup	36
3.7	Protocol	37
3.8	Statistical analyses	38
3.8.1	Introduction.....	38
3.8.2	Analysis of within-subject variables	39
3.8.3	Analysis of between-subject variables.....	40
4	Results.....	42
4.1	Results of within-subject analysis.....	42
4.1.1	Repeated measured analysis	42
4.1.2	Linear regression analysis.....	42
4.1.3	Angular resolution instead of screen size and viewing distance.....	43
4.2	Results of between-subject analysis.....	44
4.2.1	Summary of significant between subject variables.....	49
4.3	Average slider setting as independent variable.....	50
4.4	Checking for the size constancy effect	51
5	Discussion	52
5.1	Introduction.....	52
5.2	Within-subject variables	52
5.3	Interpretation of between-subjects variables.....	54
5.4	Size constancy effect.....	54
5.5	Model	55
5.6	Limitations	56
5.6.1	Introduction.....	56
5.6.2	Screens used.....	56
5.6.3	Images used.....	56
5.6.4	User interface	56
5.6.5	Basis of adjustment	57
5.6.6	Subject selection	57
5.7	Recommendations.....	58
5.7.1	Introduction.....	58
5.7.2	More variety in material.....	58
5.7.3	Different screen controls.....	58
5.7.4	Different screens types and dimensions.....	58
5.7.5	Different research methods	58
	References.....	60
	Appendices.....	62