Minor changes for
"Multiresolutional techniques for digital image filtering and watermarking"
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Page, figure and table numbers in blue refer to the old thesis (without minor corrections). Page, figure and table numbers in red refer to the new thesis (with minor corrctions).

Global changes

1. Images, such as those on p.86 and p.87, could be wider to show more detail (they are not the full textwidth).

   Changes:
   I have increased the width of the images on pages 22 (21), 42 (41), 72 (74), 85 (87), 86 (88), 87 (89), 91 (93), 92 (94), 93 (95), 95 (97), 96 (98), 97 (99), 99 (101), 100 (102), 101 (103), 106 (109), 107 (110), 133 (145) 140 (151), 166 (179), 176 (190), 242 (218), 243 (219), 246 (222), 248 (111), 249 (112), 250 (113), 251 (114), 252 (115), 253 (116), 254 (117), 255 (118) so that they are slightly wider than the width of the text. Similarly, I have increased the width of the graphs on pages 169 (182), 170 (183), 178 (192), 188 (255), 189 (256), 202 (269), 203 (270), 207 (274), 219 (282), 220 (283), 223 (286), 226 (289).

2. Figure and table captions need to convey more information so that the reader does not have to search through the text to find out what is going on.

   Changes:
   Various captions on figures and tables have been expanded to give more information. These changes can be seen clearly by looking at the *List of Figures* and *List of Tables* (on pages *xi* (*viii*) and *xv* (*xi*), respectively).

   - Figures captions altered: 2.1 (2.1), 2.2 (2.2), 2.3 (2.3), 2.4 (2.4), 2.5 (2.5), 2.12 (2.12), 3.4 (3.4), 4.2 (4.2), 4.3 (4.3), 7.2 (7.2), 7.3 (7.3), 7.7 (7.7), 7.10 (7.10), 9.3 (9.3), 9.4 (9.4), 9.5 (9.5), 9.6 (9.6), 9.7 (9.7), 9.8 (9.8), A2 (A2), A3 (A3), A4 (A4), C1 (B1), C2 (B2).
   - Tables captions altered: 3.1 (3.1), 5.1 (5.1), 5.2 (5.2), 5.3 (5.3), 5.4 (5.4), 7.1 (7.1), 7.2 (7.3), 7.3 (7.4), 7.4 (7.5), 7.5 (7.6), 7.6 (7.7), 9.1 (9.1), 9.2 (9.2), 9.3 (9.3), 9.5 (9.5), 9.6 (9.6), 9.7 (9.7), 9.8 (9.8), 10.2 (H.1), 10.3 (H.2), 10.4 (H.3), 10.5 (H.4), 10.6 (H.5), 10.7 (H.6), 10.8 (H.7), 10.9 (H.8), 10.10 (H.9), 10.11 (H.10), 10.12 (H.11), 10.13 (H.12), 10.14 (H.13), 11.1 (H.14), 11.2 (H.15), 11.3 (H.16), 11.4 (H.17), 11.5 (H.18), 11.6 (H.19), 11.7 (H.20), 11.8 (H.21), 11.9 (H.22).

3. Avoid orphans (single words or lines at the top of the page) if possible.
   Changes:
   There are no more orphans.

4. Look at the possibility of using larger margins (not essential).
   Changes:
   Kept margins the same size, but increased the width of images and graphs (as mentioned above).

5. Glossary. Are all of these abbreviations necessary? e.g. Gaus. for Gaussian and FP for filter performance etc.? Again, infrequently used abbreviations can be hard work for the reader.
   Changes:
   The following abbreviations are no longer in the thesis (expanded versions of these abbreviations are used instead): Av. filt (average filter), CLB (configurable logic block), DEC (decoded), Gaus. (Gaussian), IP (intellectual property), LUT (look up table), SSKF (symmetric short kernel filter), UNC (uncoded).
   The following abbreviations are now used in equations only (in Section 4.4.2, p.80), their use in

the rest of the thesis (*e.g.* Section 5.1.1[1], p.86), is now extinct (full text used instead): ES (edge sharpness), FP (filter performance), SP (this *speckle reduction* abbreviation has been replaced by the more informative NR_h and NR_e (noise reduction homogeneous and noise reduction edge)).

Structural change

Shorten and combine the final chapters on different error coding strategies, detailed results can be put into appendices if desired. As a rough guide, the page count for this section should be similar to those of the noise filter and new watermarking technique.

Changes:

Old Chapters 10 and 11 combined into a single summarising chapter (Chapter 10, p.196) which is only 9 pages long. This new short chapter drives home the main findings of the detailed results and analysis which have now been shifted into the appendix (Appendix H, p.252).

Questions/changes

Chapter 1

1. Abbreviations not spelt out first occurrence, e.g. p.3 ECC, DCT, BCH.
   Changes:
   ECC, DCT and BCH were expanded in the Abstract (this is why, initially, I did not expand them on p.3, but I have now expanded them on p.3 too). I have double checked the rest of my abbreviations and made sure that they are fully spelt out on their first occurrence.

Chapter 2

1. p.8 "speckle is not noise". Untrue. Clarify that noise is any unwanted signal, regardless of whether or not it is stochastic or stationary.
   Changes:
   Previous sentence of:
   This interference results in "blobs" of different shape, size and position to appear on the generated image, i.e., the image has been corrupted by speckle.
   has been replaced with (p.7):
   This unwanted interference causes "blobs" of different shape, size and position to appear on the generated image, i.e., the image has been corrupted by speckle noise.
   The paragraph proceeding this sentence (arguing that speckle is not noise) has been removed.

2. p.9 Unclear argument here. Make it clearer that homomorphic method (logarithm) is not the implementation of the linear approximation described before it.
   Changes:
   The paragraphs (p.8) describing the linear approximation method and the homomorphic method have been reworded to make it clear that these two methods are seperate from each other.

3. p. 28 reference [34] "Kivanc" should be replaced by "Mihcak".
   Changes:
   Kivanc replaced by Mihçak ([34], p.294).

4. p. 30 Regarding thresholding methods, suggest inclusion of P. Moulin and J. Liu, "Analysis of Multiresolution Image Denoising Schemes Using Generalized Gaussian and Complexity Priors" *IEEE Trans. Info. Theory* 1999;45(3):909–919. The link to image statistics in transform domain (wavelets in particular) is an essential part of this analysis.
   Changes:
   Moulin and Liu reference has been added. Paragraph describing the link between wavelet shrinkage denoising and MAP estimates added to Section 2.3.1, p.28.

[1] main section discussing results of denoising filters

Chapter 3

1. p. 44 Regarding the issue of noise statistics in the undecimated transform domain. It is mentioned in Table 3.1, however the problem of correlated noise in this domain should be discussed further. All thresholding techniques (c.f. Moulin & Liu) are developed on the assumption of i.i.d. Generalized Gaussian image statistics, and additive i.i.d. Gaussian noise using MAP estimation. However, that does not hold in this case. See later p.53: your main idea to cope with the correlated noise is to have a spatially varying threshold value. Partially it is a valid assumption, just not completely justified. The correlated structure of noise in the undecimated domain assumes that the noise samples in some neighborhood will be correlated, and it suggests proceeding with window-based processing rather than simple pixel-wise one to capture these relationships.
   Changes:
   Section 3.3, p.61, renamed *Summary and Future Work*. It is pointed out on p.62 that future work should focus upon a window based method for ascertaining the noise terms in an *à trous* wavelet level rather than the current pixel-wise method (as the window based method is better).

2. p. 63 "Soft thresholding wavelet coefficients is known to provide...." Usage of hard or soft thresholding depending on their smoothing/preserving properties as suggested in [46] is not a well-justified theoretical argument. In fact, according to Moulin & Liu, the hard and soft thresholdings are the particular cases of the MAP estimate for various stochastic image priors.
   Changes:
   Section 3.3, p.61, renamed *Summary and Future Work*. On p.62, it is stated that hard and soft thresholding are particular cases of MAP estimates for stochastic image priors and that future work should consider these cases.

Chapter 4

1. p.68 Describe how the Watson metric is calculated.
   Changes:
   New section added (Section 4.1.3, p.68) which describes the how the Watson metric components of contrast sensitivity, luminance masking, contrast masking and error pooling are calculted mathematically.

2. The fair comparisons later on depend critically on the fairness of this perceptual quality measure. You should include a little more text and references to support its use in this role.
   Changes:
   Extra references, which utilised the Watson metric, now included (Section 4.1.2, p.66).

Chapter 5 (and onwards)

1. p.85 Table 5.1 would be useful to have values for when no filtration is used (likewise table 5.4, p.99).
   Changes:
   Tables 5.1, 5.2, 5.3 and 5.4 (pages 87, 93, 97 and 101) now have an extra row describing the results for the unfiltered images.

2. p.104 What did you learn from the clinical evaluation? (basically people preferred what they were used to, they preferred the new technique as it changed the image appearance least, which is a biased result).
   Changes:
   An extra paragraph added to Section 5.2.2, p.107, describing why saying the wavelet filter is the most preferred is a biased result. To the final paragraph, an extra few lines have been added (p.108) saying that a more rigorous visual qualitative evaluation procedure could have been used (including a brief description of how to do this). Extra changes:
   Denoised ultrasound images have been moved from Appendix B, p.247, to the main body of the thesis (Section 5.2, p.111).

3. p.130 Table 7.1 etc. No range or standard deviation given to indicate distribution and back up claim about outlier on p.129 (reason for $\sigma^2 = 375$ rather than 600).
   Changes:
   Ranges (minimums and maximums) and standard deviations added to Tables 7.1, 7.2, 7.3, 7.5, and 7.6 (p.141 onwards). Table 7.2 is new and details the results for a Gaussian noise attack of $\sigma^2 = 600$ which, along with new text added in Section 7.6.2 (p.142), explain the outlier result.

4. p.134 List number of failures in Table 7.2 as in 7.1.
   Changes:
   Rows reporting the number of failures added to Tables 7.2, 7.3, 7.5 and 7.6.

5. p.146 (chapter 8 onwards) remove % from JPEG quality factor.
   Changes:
   All the % signs associated with JPEG quality factors have been removed.

6. p.133 etc. Watermark attack described as "cropping" does not attempt to desynchronise the watermark, just reduce its energy (since the remaining pixels are in their original location). Likewise the "scaling" does not change the image size to desynchronise the watermark but merely induces error from the downscale and nearest-neighbour interpolation. The targeted scenario is robust watermarking. Real watermarking attacks include both signal processing attacks (e.g. compression, filtering, etc.) aiming at the removal watermark or it energy decrease, and geometrical attacks, which aim to desynchronise the watermark (c.f. Stirmark or Checkmark). Only signal processing attacks have been addressed here. However, the goal of attacker is to fool the detector (decoder) by introducing desynchronization. The task of decoder is to estimate what has happen to the watermarked image and to apply the resynchronization accordingly. To avoid all possible criticism you should state clearly somewhere that geometrical benchmarking was not your primarily goal and that you are assuming the presence of some synchronization mechanism (provide suitable references).
   Changes:
   New section added (Section 6.4, p.124) which distinguishes between signal processing attacks and geometrical attacks. A list of references (p.125) has been added pointing to articles that describe techniques for decoder resynchronisation after geometrical attack. In Section 7.6.2, new text added (pages 141 and 142) pointing out that the cropping attacks and half sizing attacks performed in this chapter are not geometrical attacks and that some sort of decoder resynchronization procedure is assumed. In the rest of this chapter, cropping is refered to as "cropping" and half sizing is referred to as "half sizing".

7. p.165 Table 9.2 headings confusing, mean and std should be combined with JPEG quality range (i.e. quality should span 3 columns, cf. table 7.1, p.130). Also table 9.5 on p.174.
   Changes:
   Tables where quality made to span three columns (as suggested): 9.2, 9.5, H.2, H.8, H.10, H.12, H.13, H.14, H.16, H.17, H.19, H.20, H.22.
   Extra changes:
   In tables 10.4 (H.3), 10.10 (H.9) and 10.12 (H.11), multi-column *ROC Area* moved from mid-table to top of table.
   In tables 9.2 (9.2), 9.5 (9.5), 10.3 (H.2), 10.9 (H.8), 10.11 (H.10), 10.13 (H.12), 10.14 (H.13), 11.1 (H.14), 11.3 (H.16), 11.4 (H.17), 11.6 (H.19), 11.7 (H.20), 11.9 (H.22), *Std.* now used as abbreviation for *standard deviation*.
   In tables 7.1, 7.3, 7.4, 7.6 and 7.7, *QF* now used as the abbreviation for *Quality Factor* (to match rest of thesis).

8. p.171 Explain/define PIM.
   Changes:
   PIM overview expanded from a rough summary (in a few lines) to a more detailed explaination (a paragraph in length including a mathematical description of PIM), p.184.

9. p.196 underlining far too subtle (try bold font instead).
   Changes:
   Underlined values now changed to blue colour, p.263.

10. Reword "drastically" (cannot remember where it occurred!).
    Changes:
    Bottom of Page 102 (104), *drastically* removed.
    Top of page 151 (164), *drastically* changed to *quite considerably*.
    Top of page 231 (207), *drastically* removed.

Viva examiners, 4th November 2005

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- Dr. Sviatoslav Voloshynovskiy, University of Geneva.