Response to Recommendations Report

Roy S. Schestowitz

February 24, 2010

This document details very precisely changes that were made to the thesis, in accordance with the report on the resubmitted thesis. Here is the report's summary:

The thesis is much improved. Most of the recommendations for amendment have been implemented satisfactorily.

The review of non-rigid registration methods has been extended to include feature-based methods.

The overall structure is improved, particularly around chapters 4 and 5. Chapter 4 now gives a clearer explanation of the Minimum Description Length methods and makes explicit the relation between the objective function used in this study and the MDL objective function which has been used for model optimisation. The preliminary experimentation is clearer.

Chapter 5 is largely rewritten and is much improved. There remains some lack of clarity, particularly around section 5.4.1. Figure 5.19, and the comparison of this figure with figure 5.17 remain mysterious.

The figures showing MR images in this chapter are of poor quality, usually they are too small to be able to see what is intended (fig 5.22 and 5.23-5.29 and 5.31) The images in these figures could be made larger and clearer without affecting the overall pagination.

Chapter 6 is improved, although the term K-L divergence is used without explanation, or even a definition of what KL stands for (p. 126).

Chapter 7 is improved, but figures 7.2 and 7.3 share the same quality problems as those in chapter 5 (see above).

Here are the recommended changes and the response/s to each. The report says:

There are a number of places where minor textual improvements could be made (refs are page.line, negative line numbers refer to counts from the foot of the page):

80.3: "MDL takes the Shannon result and finds complex data to shorten." I don't know what that means.

This sentence was rewritten to clarify. It now says: "MDL uses the Shannon result to identify data which can be compressed and it then shortens the message required to transmit this data." (page 81 at the bottom)

80.5: "umpteen events" Too informal.

This was made more formal by saying: "This gives a minimum total message length for transmitting the occurrence of events $\{i_1, i_2 ... i_\eta\}$, where η is the number of events considered." (page 81, paragraph 1)

83.-6: "...the sum of the lengths of the accuracy..." What does "length of the accuracy" mean?

This is indeed poorly phrased or vague. Rewritten to say: "The total code length was the sum of the lengths of the data describing parameter accuracy and the quantised parameters." (page 84 at the bottom)

84.1: "wrt" rather than "with respect to" (there are other occurrences of this.)

I identified 7 places in the text where I have swapped these.

p84 ff. Newly added equations are not numbered.

All the equations in the thesis are numbered now.

119.5: "To tolerance, value changes are made by scaling up or down a few orders of magnitude each time (3-10 decimal places, in addition to 15)." Unclear.

This was rephrased to say it more simply and precisely: "At each stage, a different scale of refinement was chosen such that the scale values increased orders of magnitude each time (the numbers used here were 3 decimal places, 5 decimal places, 7 decimal places, 10 decimal places, and 15 decimal places, corresponding to 0.001, 0.00001, and so on)." (page 123, paragraph 2)

p126.2 ff: The text referring to the comparison between figures 5.17 and 5.19 is very unclear , and the message remains obscure. This text should be clarified.

Experiments were rerun and new figures put in place of the old ones. This means that the figures (results) and text found in 5.3.1 and 5.4.1 are significantly changed.

A new subsection, 5.3.1 (page 113), has been added. As suggested before, this gives typical results of running the basic NRR method proposed. This includes new figures that show bumps pre and post alignment, the value of the objective function over 1000 iterations, and the mean distance from the correct solution over 1000 iterations. The results are not perfect but are fairly convincing. They are being discussed.

In 5.4.1 (page 128), it was agreed that I remove Figure 5.17 and Figure 5.18. These figures were really in the wrong place and did not show very convincing results (superseded by a new subsection, 5.3.1). The figures substitution is replacing Figure 5.19 with new a figure showing the modes of a combined model. The text was rewritten to discuss these results; the complication of shape-only and intensity-only models – which was not at all clear or illuminating – was dropped from the figures.

The MR images in figures 5.22, f.23-5.29, 5.31 and 7.2 and 7.3 should be improved in quality. This may simply involve making the images bigger.

All of these figures were made larger and captions changed very slightly to account for new positioning (in Chapter 5). Figure 5.31 was made as large as possible given constraints of layout (it was made just 20% larger).

147.-6: Explain what KL divergence is and why it is relevant.

"Kullback-Leibler" is mentioned now. In Chapter 6, it says: "Twining and Taylor recently showed that, by using Kullback-Leibler (KL) divergence, one can extract the same type of measures based on a sound theoretical basis. This will be further explained in Chapter 9." (page 152)

The relevance was added to Chapter 6 as follows: "The KL divergence is essentially the relative entropy which measures the difference between two probability distributions, which in this case are the training images and the model pdf corresponding to these images." (page 152)

p154, Fig 6.3: This doesn't correspond exactly to the text. It implies that a neighbourhood is sampled in each image to compare with the other, whereas the text refers to a 1-way comparison.

The text was amended to clarify what the image shows. The caption says: "Note that this diagram shows the symmetric calculation, whereas in experiments we

use an asymmetric (one-way) calculation." This point was previously made in the text, but the figure alone may prove deceiving, so the caption was expanded. (page 159)

171.12: "Ways of combining these...is not trivial."(are not trivial)

188.5: "vertexes" should be "vertices"

Fixed. The corrections can be seen in pages 176 and 193, respectively.