Corrections for thesis from draft v01 to draft v02

Miguel P Xochicale

October 8, 2018

Abstract

This document presents a log book for the corrections of the hand written comments of Chris Baber (CB) made on 21 of August 2018 for the thesis draft version 01. These comments of draft 01 are located in *.../revisions/draft01-21august2018/comments/*.pdf*.

With regards to my corrections (MX), chapter one has been fused with chapter two of draft 01, and research questions have been slightly amended. Chapter two has been added and the chapter for the conclusions has been amended (but still unhappy about its quality)!

Contents

1 Major corrections (CB) 2
- 1.1 chapter 2 . . . 2
- 1.2 chapter 4 . . . 6
- 1.3 chapter 5 . . . 8
- 1.4 chapter 7 . . . 9
- 1.5 chapter 8 . . . 13

2 Minor Corrections (CB) 13
- 2.1 title . . . 13
- 2.2 toc . . . 14
- 2.3 chapter 1 . . . 14
- 2.4 chapter 2 . . . 14
- 2.5 chapter 3 . . . 14
- 2.6 chapter 4 . . . 14

3 General corrections (MX) 14
- 3.1 chapter 1 . . . 14
- 3.2 chapter 2 . . . 15

1 Major corrections (CB)

1.1 chapter 2

1. (p. 9) 2.2 "So - if you talk of 'error' What is this with references to? What is the nonerror signal? How is V_e actually specified/measured? What does V_{nl} mean and how it is measured?"
(p. 10) $V_e = V_{eb} + V_{ee} + V_{em}$, so this say that V_e is made up of different components but how these are measured?
(p. 10) What I don't see from this is an explanation on how variability is modelled or measured here.

```
Hence, \citealt[p. 1328]{preatoni2010} concluded that the total variability
represent the changes of contributions for $V_e$ and $V_{nl}$
and it is defined as $V_{tol}=V_e+V_{nl}$, where $V_{tol}$
"may reveal the effects of adaptation, pathologies and skills learning".
Also, \cite{preatoni2013} noted that their work only investigate error from
biological variability (e.g. $V_{eb}$) which does not consider non-biological noise
resulting from measuring instruments or data post-processing techniques, such
non-biological noise has high frequency components that are usually removed.
Therefore, the work of \cite{preatoni2010} and \cite{preatoni2013}
do not consider an overall index to quantify movement variability but
the combination of both $V_{eb}$ and $V_{nl}$.
With that in mind, \cite{preatoni2007} analysed the influences of
$V_{eb}$ and $V_{nl}$ for movement repeatability by comparing
entropy measures (e.g. ApEn and SampEn) with values of their surrogate counterparts.
```

SORTED: Tue 4 Sep 12:02:35 BST 2018

2. (p. 10) It would be useful to give an example here to show how the parameters are measured and how they interact with each other.

```
For the experiment, \cite{muller2004} considered an skittle task,
where participants throwing a ball with a string that swings around
a center post with the objective of knocking down the skittle at the opposite site.
Hence, \cite{muller2004} proposed $D$ as the absolute average of distance to
the targets in $n$ trials and it is used as a measure of the collective performance
that combines a function for movements results based on the execution vector
with a function for the minimum distance from the target $d$.
Therefore, the overall difference in performance $D$ is decomposed
into three unequal contributions of covariation $C$,
noise reduction $N$ and task tolerance $T$.
Considering a 2-D task spaces that spanned the release angle $\alpha$
and absolute velocity $v$, the components of contributions of
variability were calculated from five data sets ($A$, $A_0$, $A_{shift}$, $B$ and $B_0$):
(i) the component of covariation where sets $A$ and $A_0$ and $B$ and $B_0$
have the same means and variances,
(ii) the component of tolerance where sets $A$ and $A_{shift}$ differ only on
their location in the task space, and
(iii) the component of noise where sets $A_{shift}$ and $B_0$ have the same
means but different variances (see Fig.6 in \cite{muller2004} for further details).
With that in mind, \cite{muller2004} conducted an experiment with forty-two participants
for five different locations of the target skittle where for each target a participant
performed 320 trials which is a total of 1600 trials and therefore presented
statistical confirmation of the contributions of $T$, $N$ and $C$ using ANOVA.
```

SORTED: Tue 4 Sep 15:02:33 BST 2018

3. (p. 11) So, this discussion needs a definition (in maths) of what is variability and what affects it.
(p. 11) "secondary blooming of variability" What do you mean?

```
\cite{seifert2011} investigated coordination profiles for recreational and
competitive breaststroke swimmers and proposed an hourglass model of variability
that illustrates the amount of variability as a function of expertise.
Hence, \citealt[p. 551]{seifert2011} stated
recreational swimmers would show a considerable amount of intra-variability
"as they seek an individually appropriate coordination pattern to accommodate
the novel constrains of locomotion in water", whereas experts swimmers,
after a considerable practice,
will still explore new environments to optimise their technique that
create another secondary blooming of variability which is
the result of "the environment exploration to optimise their technique
with their individual strengths (e.g. physical, anatomical, mental, etc.)
and to gain an advantage over competitive swimmers".
To test the hourglass model of variability,
\cite{seifert2011} considered the continuous relative phase (CRP)
between the elbow phase angle and knee phase angle, therefore CRP
is used as an indicator on how swimmers synchronise
arm recovery (elbow extension) and leg recovery (knee flexion).
Then, \cite{seifert2011}
analysed inter-individual variability of swimmers with the shape of the curves
of CRP which provide an indication of the inter-limb coordination, applied
statistical measures such as hierarchical clustering using eleven variables of CRP
to classify the recreational swimmers into three cluster of coordinations
(intermediate, most-variable and in-phase)
and used Fisher information to test which CRP variables were significantly
differientiated the clusters. With that, \cite{seifert2011} concluded that
inter-individual coordination variability for recreational swimmers could be
the result of (i) different state of process learning, (ii) environmental
constraints (different perception of the aquatic resistance), or (iii)
different perception of the task constrains (floating instead of swimming).
```

SORTED: Wed 5 Sep 10:19:27 BST 2018

4. (p.10) So how do the two approaches (actually three: preatoni2013, muller2004 and seifer2011) differ and (more importantly) What are they missing?
(p.11) good, and why would nonlinear dynamics be appropriate?

```
Generally, the previous approaches reported different models
for movement variability which then are quantified with different tools.
For instance, \cite{hatze1986} and \cite{preatoni2010, preatoni2013}
use entropy measures as the authors consider that the origin of the
signals in the human body is the result of deterministic and
stochastic processes, whereas
\cite{muller2004} and \cite{seifert2011} reported only
statistics as a measure of magnitude that limited the evaluation of the
whole trajectories as structures of movement variability in human body activities.
Therefore, for this thesis, it is important to note that
even with the proposed models for movement variability
\citep{hatze1986, preatoni2010, preatoni2013, muller2004, seifert2011}
which have been quantified it using either statistical or nonlinear tools,
little has been investigated with regards to the reliability of the nonlinear
```

```
tools when using real data that has the property of being noisy, deterministic,
stochastic or nonstationary \citep{newell1998}.
```

SORTED: Wed 5 Sep 13:15:05 BST 2018

5. (p. 11) This is a bad sentence that has the end repeat the start

   ```
   Sentence has been crossed-out
   ```

   SORTED: Wed 5 Sep 14:00:25 BST 2018
   (p. 11) Explain the formula and why this is unacceptable.

   ```
   Hence, \cite{hatze1986} proposed measures of dispersion (e.g. Fourier series and
   entropy measures) to quantify the deviation of motion from a certain reference.
   For which, \cite{hatze1986} pointed out that the combination
   of deviations from angular coordinates (radians) and linear coordinates (meters)
   for Fourier series were unacceptable as the units are different.
   Hence, \cite{hatze1986} proposed the use of entropy as a global quantifier
   for motion variability and concluded that any movement deviation on a body join
   may be the result of deterministic and stochastic causes.
   ```

   SORTED: Wed 5 Sep 14:01:21 BST 2018
6. (p. 11) So entropy sounds to me like a measure of the stability of a signal? I guess Hatze says anything that changes with time can be shown to be stable? But you don't say why he calls it 'transentropy' or what is and how it is defined.
   (p. 12) You don't explain the difference between stability and variability or what entropy is intended to measure
   (p. 12)Of course it is because these are jus variations of the measure why is this useful to say?
   (p. 12) So – what do you here is name approaches without (a) explain them or (b) critiquing them. If you intent to intent to describe in more depth in a later chapter, say so. Also, explain why these approaches are necessary for your thesis.

   ```
   * "Section 2.2.1 Measures of Variability" of draft02 has been moved and
   fused with "Chapter 2: Quantifying Movement Variablity " for draft03
   * Also, Chapter two answer the previous questions, specifilly the
   question of 'why these approaches are neccesary for the thesis?'
   ```

   SORTED: Wed 5 Sep 14:15:00 BST 2018

7. (p. 13) Why did they do this study?
   (p. 13) What were the results?

   ```
   For example, \cite{guneysu2014} conducted experiments with children for upper
   arm rehabilitation using a play-like child robot interaction.
   \cite{guneysu2014}, using a Kinect sensor to get data of join angles of
   the participants‘ skeleton, studied automatic evaluation of three upper body
   actions (shoulder abduction, shoulder vertical flexion and extension,
   and elbow flexion) of eight healthy children who mimicked an humanoid robot.
   To evaluate motion imitation, \citealt[p. 202]{guneysu2014} considered similarity
   error using Dynamic Time Warping (DTW) that penalise large angle errors over ten
   percent in the area range of the motion type and applied recall measure
   as a representation of "how much of angular area of the baseline motion
   from the humanoid robot is also covered by the child's motion".
   Then, \cite{guneysu2014} presented the evaluation of five physiotherapists using
   Intraclass correlation coefficient (ICC) which a metric for reliability of
   ```

```
ratings for motion types, and reported that for the first motion, which
consists of only one join, the metric and physiotherapist evaluations
showed hight agreements, whereas for the second and third motions,
which motions were harder and complicated consisting of more join values,
the evaluation between the metrics and physiotherapist presented differences.
\citealt[p. 203]{guneysu2014} stated that during the evaluation of complicated
and harder movements, children misperceived the actions for which "therapists
compensated such misunderstanding by giving hight scores to the children
while the proposed system only considered angles".
With that, it is interesting to note that the proposed metrics of similarity
error and recall measure with the ICC metric are not totally reliable since
they did not model complex movements (involvement of multiple joins).
```

SORTED: Wed 5 Sep 18:30:17 BST 2018

8. What actions? (p. 13)

```
Recently, \cite{guneysu2015} presented variation of movements from four
physiotherapists performing five actions repeated ten times each:
opening a door with a key, touching the opposite shoulder with hand,
taking an object from back to neck, taking an object from the back and
reaching an object above the head.
```

SORTED: Wed 5 Sep 20:22:05 BST 2018

9. So – the studies done to data have used small samples and had incomplete analysis. What do they tell us? (p. 14)

```
For the previous works of quantifying human-robot imitation activities where
only traditional statistics are applied,
(i) it is not only clear how \cite{gorer2013} performed the evaluation of
synchronisation for gestures between participants and the humanoid robot
but also the evaluation for gestures is just visual,
 whereas (ii) little has been investigated with regards to the
differences in movement of the invited physiotherapists in the work of
\cite{guneysu2014} and  \cite{guneysu2015}.
Therefore, it is noted that applying nonlinear analyses instead of
traditional statistics in the context of human-robot interaction
might provide a better quantification and understanding human movement.
```

SORTED: Thu 6 Sep 11:16:10 BST 2018

10. Explain in more detail (p. 14)

```
Two participant's movement positions were presented with twelve trajectories each
(four dance activities times three trials) of z and x directions obtained with
a Kinect sensor.
```

SORTED: Thu 6 Sep 11:31:34 BST 2018

11. It would be good to know more about the data (p. 14)
    So – how will your thesis fill these gaps? (p. 14)

```
The following section
\section{Gaps in the study of Movement Variability in the
context of Human-Humanoid Interaction}
was fused with
\section{Movement Variability in the context of Human-Humanoid Interaction}
in which works of
has been reviewed  and then pointed out
how their limitations can be tackled in this thesis.
```

SORTED: Fri 7 Sep 13:06:10 BST 2018

1.2 chapter 4

1. explain what is meant by an embedding parameter (p. 21)

```
The method of state space reconstruction is based on uniform time-delay
embedding which is a simple matrix implementation considering the embedding
parameters ($m$ and $\tau$), therefore, matrix represents the reconstruction
of an unknown $d-$dimensional manifold $M$ from a scalar
time series (e.g. one-dimensional time series in $\mathbb{R}$).
```

SORTED: Mon 10 Sep 10:04:07 BST 2018

2. you haven't explained 'attractor' or how this is folded (in a manifold) (p. 25)

```
Then, if $\Phi$ is an embedding of an attractor (i.e. evolving
trajectories) in the reconstructed state space, a composition of functions
represented with $F^t$ is induced on the reconstructed state space:

.
.
.


attractor (i.e. evolving trajectories in a state space)
```

SORTED: Mon 10 Sep 14:08:24 BST 2018

3. not sure I see this at $m \geq 5$ don't these equal to one. (p.28)

```
Althought the $E_2(m)$ values for the chaotic time series tend to be closer to
one as $m$ increses, these are different to one (Fig~\ref{fig:e1e2}C),
for which, it can be concluded that the chaotic time series comes
from a chaotic deterministic signal.
...
Then, contrary to the $E_2(m)$ values for a chaotic
Lorenz time series, all values of $E_2(m)$ for a noise time series are
approximately equal to one (Figure~\ref{fig:e1e2}D).
```

SORTED: Mon 10 Sep 15:39:12 BST 2018

4. report in the last chapter (p. 29)

```
Negatives of False Nearest Neighbor were moved to future work section
```

SORTED: Mon 10 Sep 15:45:54 BST 2018

5. give numbers to define these (p. 31)

```
For small $\tau$ ($\tau < 3$), AMI will be large ( $I(\tau)>6$)and as
$m$ increase AMI will then decrease rapidly.
```

SORTED: Mon 10 Sep 16:21:32 BST 2018

6. (p. 28) so – how does this compare to page 28?
(p. 32) so, which one do you use and why?

```
\subsection{Minimum embedding parameters}
The method to select minimum embedding parameters ($m_0$ and $\tau_0$)
for this thesis is firstly to compute $m_0$ with FNN algorithm
(considering a threshold of 0.05 for $E_1(m)$ values), secondly
to compute $\tau_0$ with AMI which does not need any extra parameters.
Hence, from the previous example of the chaotic deterministic
Lorenz system, Fig \ref{fig:e1e2}(A) is used to determine the minimum
dimension embedding with a value of seventeen ($m_0 =6$) and
Fig \ref{fig:amis}(A) is used to determine the minimum delay embedding
with a value of seventeen ($\tau_0 =17$).
Therefore with the selection of the minimum embedding parameters, the
reconstructed attractor is created in order to ensure with $\tau_0$ the
maximum independence between $x(t)$ and $x(t+\tau_0)$ and with $m_0$
allowing the trajectories in the reconstructed state space to be unfolded.
```

SORTED: Tue 11 Sep 11:01:20 BST 2018

7. (p. 32) so – do you need this section?

```
section: Other methodologies for state space reconstruction
has been moved to future work in chapter 7.
```

SORTED: Tue 11 Sep 11:03:47 BST 2018

8. You haven't defined this or explained it (p. 38)

```
Lyapunove exponents are briefly explained in
{chapter2/chapter} %Quantifying Movement Variability
```

SORTED: Tue 11 Sep 11:07:05 BST 2018

9. (p. 41) I think that the chapter shows quite well that you understand the various methods and can explain them. Why you don't do is explain why you will use these particular methods.
- Why are they appropriate to the type of data you intent to collect,
- the type of variability you expect to see,
- or the type of analysis you intent to make? You should explain your choice of method to the reader.

```
Therefore, considering
```

```
(i) the strengthens and weaknesses of different nonlinear tools when
using real-world data which is nonstationarity, noisy and has different
sampling rate and length (Section \ref{nonlieaRealdata}),
(ii) not only the model of \cite{stergiou2006} where complexity and
predictability variables can characterise movement variability but also
the dependency of the task dynamics
\citep{vaillancourt2002, vaillancourt2003}
(Section \ref{what_to_measure_with_MV}), and
(iii) the selection and application the right tools in order to quantify MV
(Section \ref{which_NT_are_appropriate_to_measure_MV}).
We therefore explore, in this thesis, the sensitivity and robustness of
the window size of time series, embedding parameters for RSS with UTDE
and recurrence threshold for RP and RQA in order to gain a
better insight into the underlying time series collected from inertial
sensors in the context of human-humanoid imitation activities.
```

SORTED: Tue 11 Sep 13:29:38 BST 2018

1.3 chapter 5

1. This should be written as an Experiment Method Chapter:
   1. Aims
   2. Participants
   3. Equipment
   4. Procedures / ethics
   5. Data preparation

   each section should have detail to allow the experiment to be replicated
   I would expect this chapter to be 10 pages long (at least)

```
Updated Outline for chapter

2 Experiments
2.1 Aims
2.2 Participants
2.2.1 Human-Image Imitation Activities
2.2.2 Human-Humanoid Imitation Activities
2.3 Equipment
2.4 Ethics
2.5 Experiments
2.5.1 Human-Image Imitation Activities
2.5.2 Human-Humanoid Imitation Activities
2.6 Preparation of time series
2.6.1 Raw time-series
2.6.2 Postprocessing time-series
2.6.3 Normalization of time-series
2.6.4 Smoothing time-series
2.6.5 Window size of time-series
```

SORTED: Wed 12 Sep 14:31:29 BST 2018

2. 5.1, 5.2 and 5.3 (each of these) could be illustrated from the images from the images from your instructions (p. 45)

```
%%---------------------------------(FIGURE)-------------------------------------
\begin{figure}
  \centering
  \includegraphics[width=1.0\textwidth]{hii}
    \caption{
{\bf Human-image imitation (HII) activities.}
%Human-image imitation (HHI) activities for
(A) HII of horizontal arm movement,
(B) image of the profile view for horizontal arm movement,
(C) image of the top view for horizontal arm movement,
(D) HII of vertical arm movement,
(E) image of the profile view for vertical arm movement, and
(F) image of the top view for horizontal arm movement.
(B, C, F and E) show '(((BEAT)))' to indicate the participants
arm movements synchronisation when hearing a beat.
        }
    \label{fig:hii}
\end{figure}
%%---------------------------------(FIGURE)-------------------------------------
```

SORTED: Wed 12 Sep 14:26:18 BST 2018

3. (p. 45) Ethics – you should say that the design of the experiment adhered to UoB regulations. Data were anonymised and stored only on your computer. Participants provided informed consent and were free to withdraw from the study (p. 45).

```
\section{Ethics}
For the experiments of this thesis conducted in November 2016,
participants confirmed reading and understanding the participant information
sheet for the experiments and were able to withdraw from the experiment
at any time without giving any reason.
The design of the experiments is adhered to University of Birmingham
regulations and data were anonymised and stored only a personal
computer in accordance with the Data Protection Act 1998.
For further information about the ethics, online participation
information sheets and experiment check list, refer to
Appendix \ref{appendix:c}.
```

SORTED: Wed 12 Sep 14:27:53 BST 2018

1.4 chapter 7

1. move the underlined section to previous chapter!

```
\section{Human-Humanoid Imitation Experiment} % \label{sec:experiment}
were moved and polished to previous chapter (Time series dataset)
```

SORTED: Tue 11 Sep 13:51:14 BST 2018

2. (p. 49) "results from three participants". I don't see that these are 'space' problems for a thesis – perhaps choice of three to make comparison easier? Other data in Appendix X. (p. 55)

```
To make comparison easier, we only present 10-sec (500 samples) window length
time series for three participants (p01, p01 and p03) performing horizontal
arm movements (axis GyroZ) and  vertical arm movements (axis GyroY)
(Figs \ref{fig:tsH} and \ref{fig:tsV}), other data is presented in
Appendix \ref{appendix:d}.
```

SORTED: Wed 12 Sep 18:01:01 BST 2018

3. (p. 57) So – rather than 'individual' you use 'sample' $m + 1$ but this is a new step that you haven't explained previously. Be a good idea to anticipate this in your Metrics chapter or you move your points on page 59/60 earlier.

```
\subsection{Overall minimum embedding parameters} \label{sec:overall_minMT}
We use sample mean for an overall value of embedding minimum embedding
parameters ($\overline{m}_0$, $\overline{\tau}_0$) in which minimum values
($m_{0_i}$, $\tau_{0_i}$) are averaged over $N$ which is the total number
of minimum embedding values:
\begin{equation}
\overline{m}_0= \frac{1}{N} \sum^{N}_{i = 1} m_{0_i},
\end{equation}
\begin{equation}
\overline{\tau}_0= \frac{1}{N} \sum^{N}_{i = 1} \tau_{0_i}.
\end{equation}
```

SORTED: Thu 13 Sep 12:40:41 BST 2018

4. (p. 58) Fig 7.6 Should be bigger and clearer
   (p. 59) Figs. 7.7 and 7.8 Should be bigger and clearer

```
Figs were changed to a bigger size and look clearer.
```

SORTED: Wed 12 Sep 20:18:51 BST 2018

5. (p. 59) This sentence doesn't make sense

```
Although the implementation of Uniform Time-Delay Embedding matrix (UTDE)
is simple, the main challenge in this regard is to select embedding parameters
to reconstruct the state spaces for each time series, considering that time
series are unique in terms of its structure (modulation of amplitude,
frequency and phase) \citep{ frank2010, sama2013, bradley2015}.
With that in mind, the problem is not to compute individual embedding parameters
for each of the time series but to deal with a selecting of two parameters
that can represent all the time series.
```

SORTED: Thu 13 Sep 13:47:20 BST 2018

6. (p. 60) You should point some examples out to the reader –

```
(Section \ref{sec:rsswithUTDE}) in Chapter 3 were created
to give more details about the RSSwUTDE and examples
```

SORTED: Thu 13 Sep 19:44:32 BST 2018

what are the figures 7.9 and 7.10 showing? What are the relevant or important things to notice? I think there is at least another page of explanation provide here.

```
The RSSs for horizontal normal and faster from the human sensors (HS01)
are slightly smoothed as the time-series smoothness increase
Figs~\ref{fig:rss_aHw10}(A,C). Similarly, the smoothness of RSSs
for robot sensor (RS01) is smoothed as the time series smoothness increase.
Although the frequency of the movement increase from normal to faster velocity,
the RSSs in Figs~\ref{fig:rss_aHw10}(B)
show highers osciallations specially for a maximum values of smoothnes,
while the RSS for HF in Figs~\ref{fig:rss_aHw10}(D) show a lower and smothed
osicallations as the smoothenss increase.


Although time series for vertical movements are less noisy and well structured
(Figs \ref{fig:tsV}), the RSSs (Figs \ref{fig:rss_aVw10}) seems to be less
organised, specially for Fig \ref{fig:rss_aVw10}(A,C), while time series
for vertical faster movements (VF) having more periods (Figs \ref{fig:tsV})
create RSS with well defined patters (\ref{fig:rss_aVw10}(C,D)).
It is important to note that smoothness of time series creates also an effect
on smoothness in the trajectories of the RSS being the RS01 more organised
and more persistent while trajectories for HS01 are more changeable.
```

SORTED: Fri 14 Sep 06:32:08 BST 2018

7. (p. 61) Figs 7.9 should be bigger and clearer
   (p. 62) Figs 7.10 should be bigger and clearer

```
Therefore, considering time series for participant 01
(Figs \ref{fig:tsH}, \ref{fig:tsV}) the reconstructed state spaces
for horizontal arm movements (Figs~\ref{fig:rss_aHw10}) and
 vertical arm movements  (Figs~\ref{fig:rss_aVw10})
are computed with $\overline{m_0}=6$ and $\overline{\tau_0}=8$
(Section \ref{sec:rsswithUTDE}).
```

SORTED: Thu 13 Sep 19:46:56 BST 2018

8. (p. 62) Again – explain this figures and point out the important relevant features. Don't assume the reader will see everything that you do.

```
Generally, the increase of smoothness in time series results in ticker
and more well defined diagonal lines in the RPs
```

```
Regarding the low and hight frequencies in the time series due to the
changes in velocities of the movements, RPs patterns
show both an increase of diagonal lines and a decrease of its thickness.
Although, RPs patterns show consistency with the movements type and velocities,
it can be noticed that RPs for HS01 are not entirely well defined
while RPs for RS01 shown a more consistent pattern
(Fig~\ref{fig:rp_aV}, \ref{fig:rp_aH}).
```

SORTED: Fri 14 Sep 11:19:36 BST 2018

9. (p. 63) Figs 7.11 should be bigger and clearer

```
Amended figure size and also added a better descrition for the caption
```

SORTED: Fri 14 Sep 11:18:49 BST 2018

10. (p. 63) "HS01" Is this from one person? Explain what HS01 means, and why use these data.

```
\section{Recurrence Quantification Analysis}
Considering the RPs for 20 participants performing four activities
(HN, HF, VN and VF) with sensors attached to the human (HS01) and to the
humanoid robot (RS01) and with the increase of smoothness
(sg0zmuvGyroZ, sg1zmuvGyroZ and sg2zmuvGyroZ),
we hence compute four metrics of RQA metrics (REC, DET, RATIO and ENTR) with
embedding parameters $m=6$, $\tau=8$ and recurrence threshold $\epsilon=1$
shown in the following subsections.
```

SORTED: Mon 17 Sep 08:04:38 BST 2018

11. (p. 65) Would you expect them to change?

```
Changes in RQAs are expecting but DET values are not very evident.
```

SORTED: Mon 17 Sep 08:01:41 BST 2018

12. (p. 68) This belongs to earlier in the metrics review chapter

```
Considering the raised points with regards to the weaknesses and strengths
of RQA in Section \ref{sec:ws_rqa}, we computed and plotted ...
```

SORTED: Mon 17 Sep 17:29:03 BST 2018

13. (p. 70) Every figure should have at least one paragraph of explanation to point out key features

```
Description  of key features for the following figures
has been added:
\label{fig:topo_rqas}
\label{fig:topo_sa_hs01}
\label{fig:topo_sa_rs01}
\label{fig:topo_windows}
\label{fig:topo_smoothness}
\label{fig:topo_participants}
```

SORTED: Tue 18 Sep 14:36:38 BST 2018

14. I can see you have produced results but it is not obvious how these are meant to be interpreted. You need more explanation of the important and relevant elements of each figure. You need to say whether the results are expected and whether different methods agree or contradict each other.

```
Generally, it can be noted the changes for RQA metrics are evident
with both the increase of embedding dimension parameters and the
recurrence threshold which were expected results
because of different structures, window size, levels of smoothness
of the time series.
It is also important to highlight that the patterns in the 3D
surfaces of the RQA metrics (REC, DET, RADIO and ENTR)
(Fig \ref{fig:topo_rqas}) are certainly similar to its corresponded
metrics for the different characteristics of the time series
(Figs. \ref{fig:topo_sa_hs01}, \ref{fig:topo_sa_rs01},
\ref{fig:topo_windows}, \ref{fig:topo_smoothness},
\ref{fig:topo_participants}).
```

SORTED: Tue 18 Sep 17:48:16 BST 2018

15. I am also worried that not including any of your other data means you risk the thesis looking like a single study MSc by Research rather than a PhD.

```
data and results for the study of human-image imitation will be
ready for the final version!
```

SORTED: Tue 18 Sep 17:49:01 BST 2018

1.5 chapter 8

1. What were the research questions?
   How were these answered?
   How does your work extend and advance the field?
   (p. 73)

```
Last chapter has been reorgnised in order to answer the previous questions
\chapter{Conclusions, contributions and future work}
```

SORTED: Thu 20 Sep 10:22:25 BST 2018

2 Minor Corrections (CB)

2.1 title

- Changing title

Nonlinear Time-series Analysis for Movement Variability in Human-humanoid Interaction

SORTED: Mon 3 Sep 13:05:34 BST 2018

2.2 toc

- Comments about the use of English language!

  SORTED: Mon 3 Sep 13:19:58 BST 2018

2.3 chapter 1

- Comments about the improvement of use of English language.

- References need to be in Harvard style.

  SORTED: Mon 3 Sep 15:00:10 BST 2018

2.4 chapter 2

- All References need to be in Harvard style.
- 2.1 comments are essentially about improvement of use of English.
- when quoting someone, use page number.
- modify title of 2.4 which reads like: Gaps in the study of movement variability in the context of human-humanoid interaction (p. 14)

  SORTED: Mon 3 Sep 23:24:44 BST 2018

2.5 chapter 3

- Corrections with the use of English language
- 'Spell out acronyms in headings' e.g. RSS, RP and RQA

  ```
  Spelling errors, corrections with the use of English and
  well defined references were improved
  ```

  SORTED: Mon 10 Sep 14:00:19 BST 2018

2.6 chapter 4

- Corrections with the use of English language and citations.
  SORTED: Sep (missed to record day/time)

3 General corrections (MX)

3.1 chapter 1

1. major corrections

   ```
   Chapter2 from draft01 has been fused with Chapter 1 and
   the outline of the thesis has been updated
   ```

   SORTED: Wed 19 Sep 18:12:09 BST 2018

2. amended research questions

```
\item What are the effects on RSSs, RPs, and RQA metrics
for different embedding parameters, different recurrence thresholds
and different characteristics of time series
(window length size, smoothness and structure)?

\item How sensitive or robust are RQA metrics when quantifying MV?

\item Is it fine to smooth raw time series for the quantification of MV?
```

SORTED: Wed 20 Sep 23:59:09 BST 2018

3.2 chapter 2

```
Chapter 2: Quantification of movement variability has been added to the
draft02 which in a way answer the questions raised by CB in the draft01.
```

SORTED: Sun 9 Sep 23:44:20 BST 2018

1. Solve the following questions for the fusion of "Section 2.2.1 Measures of Variability" of draft02 with "Chapter 2: Quantifying Movement Variablity " for draft03, mainly answer 'why these approaches are neccesary for the thesis?':
   (*) So entropy sounds to me like a measure of the stability of a signal? I guess Hatze says anything that changes with time can be shown to be stable? But you don't say why he calls it 'transentropy' or what is and how it is defined.
   (*) You don't explain the difference between stability and variability or what entropy is intended to measure
   (*) Of course it is because these are jus variations of the measure why is this useful to say?
   (*) So – what do you here is name approaches without (a) explain them or (b) critiquing them. If you intent to intent to describe in more depth in a later chapter, say so. Also, explain why these approaches are necessary for your thesis.

   ```
   Previous questions are anwered with the updated chapter 2:
   "Quantifying movement variability"
   ```

   SORTED: Sun 9 Sep 23:44:20 BST 2018