CODECHECK certificate 2023-011

https://doi.org/10.5281/zenodo.8359200

Item	Value
Title	Does enforcing glenohumeral joint stability matter? A new rapid muscle redundancy solver highlights the importance of non-superficial shoulder muscles
Authors	Italo Belli , Ajay Seth
Reference	BioRxiv preprint (2023) https://www.biorxiv.org/content/10.1101/2023.07.11.548542v1
Codechecker	Stephen J. Eglen
Date of check	2023-09-18 13:00:00
Summary	Codecheck performed interactively as part of the Delft 2023 workshop.
Repository	https://github.com/codecheckers/rmr-solver

Table 1: CODECHECK summary

Output	Comment	Size (b)
`codecheck/figure3-screenshot.png`	manuscript Figure 3 (composite)	1198909

Table 2: Summary of output files generated

Summary

The codecheck was undertaken as part of a workshop at TU Delft on 18th September 2023. The codecheck was undertaken with the first author observing and able to help fix issues. This meant that the codecheck was fairly quick and any issues were resolved fairly quickly.

We identified Figure 3 as the key figure to reproduce. The other results figures (particular 5 and 6) required significantly longer computation times and so were not attempted.

During the codecheck, a hidden dependency was found. The code requires the Signal Processing Toolbox. This should be documented in the front page.

We found two problems with the code base, both presumably because the code was developed on Windows, whereas the code was checked on a Mac. First, path separators needed changing from '\' to '/'. Second,

there was an issue with some filenames having trailing spaces. This was fixed by changing the code to work with cell arrays rather than vectors of characters.

With these fixes, the code was confirmed to work and Figure 3 could be replicated. This took under 2 hours, including all installations.

Once the code ran, I selected the six figures corresponding to the six panels in Figure 3 and took a screenshot. Scientifically, the results are the same, although some visual differences are clearly seen (e.g. y axis has been edited). It was clear that there has been some post-processing of the figures before publication, as was confirmed by the author.

CODECHECKER notes

The code was written in Matlab, with appropriate licence information. There were three external dependencies required, which were clearly described. Installation of these extra software packages took about 20 minutes.

I used MATLAB2023b on a mac to perform the check. Once running, the code took about 5 minutes to generate the key results.

To run the code, I needed to run the script "PlotResults.m". This then asked for three parameters, to which I selected "FLX 2kg", "100 Hz", "100 Hz".

As well as reproducing Figure 3, we were able to reproduce one row of Table 1, "Flexion +" (Task 4). These numbers were output to the terminal when the code was run. This output was:

```
Task considered: FLX_2kg
Considering RMR results at 100 Hz (with GH constraint)
Considering RMR results at 100 Hz (without GH constraint)
Considering CMC results
Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Trapezius, scapula middle'}

CMC:          0.03 [MAE] ,0.97 [xcorr]
RMR (GH):     0.04 [MAE] ,0.94 [xcorr]
RMR (no GH):  0.04 [MAE] ,0.94 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Trapezius, scapula superior'}

CMC:          0.06 [MAE] ,0.94 [xcorr]
RMR (GH):     0.08 [MAE] ,0.92 [xcorr]
RMR (no GH):  0.08 [MAE] ,0.92 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
```

```
In PlotResults (line 334)

MAE_flx2kg
    {'Trapezius, scapula inferior'}

CMC:          0.02 [MAE] ,0.94 [xcorr]
RMR (GH):     0.02 [MAE] ,0.9 [xcorr]
RMR (no GH):  0.02 [MAE] ,0.9 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Deltoid anterior'}

CMC:          0.05 [MAE] ,0.96 [xcorr]
RMR (GH):     0.05 [MAE] ,0.94 [xcorr]
RMR (no GH):  0.04 [MAE] ,0.95 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Deltoid posterior'}

CMC:          0.06 [MAE] ,0.44 [xcorr]
RMR (GH):     0.07 [MAE] ,0.14 [xcorr]
RMR (no GH):  0.07 [MAE] ,0.16 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Deltoid middle'}

CMC:          0.06 [MAE] ,0.94 [xcorr]
RMR (GH):     0.04 [MAE] ,0.97 [xcorr]
RMR (no GH):  0.05 [MAE] ,0.95 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Pectoralis major clavical'}
```

```
CMC:          0.04 [MAE] ,0.94 [xcorr]
RMR (GH):     0.04 [MAE] ,0.88 [xcorr]
RMR (no GH):  0.02 [MAE] ,0.91 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Serratus anterior'}

CMC:          0.06 [MAE] ,0.93 [xcorr]
RMR (GH):     0.06 [MAE] ,0.92 [xcorr]
RMR (no GH):  0.06 [MAE] ,0.92 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Infraspinatus (Superior)'}

CMC:          0.02 [MAE] ,0.93 [xcorr]
RMR (GH):     0.02 [MAE] ,0.73 [xcorr]
RMR (no GH):  0.04 [MAE] ,0.56 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Latissimus Dorsi (Medialis)'}

CMC:          0.15 [MAE] ,0.84 [xcorr]
RMR (GH):     0.16 [MAE] ,0.52 [xcorr]
RMR (no GH):  0.16 [MAE] ,0.55 [xcorr]


Warning: Integer operands are required for colon operator when used as index.
> In EMG_CMC_RMR_plot (line 55)
In PlotResults (line 334)

MAE_flx2kg
    {'Teres major'}

CMC:          0.09 [MAE] ,0.4 [xcorr]
RMR (GH):     0.11 [MAE] ,0.06 [xcorr]
RMR (no GH):  0.1 [MAE] ,0.05 [xcorr]
```

```
>>
```

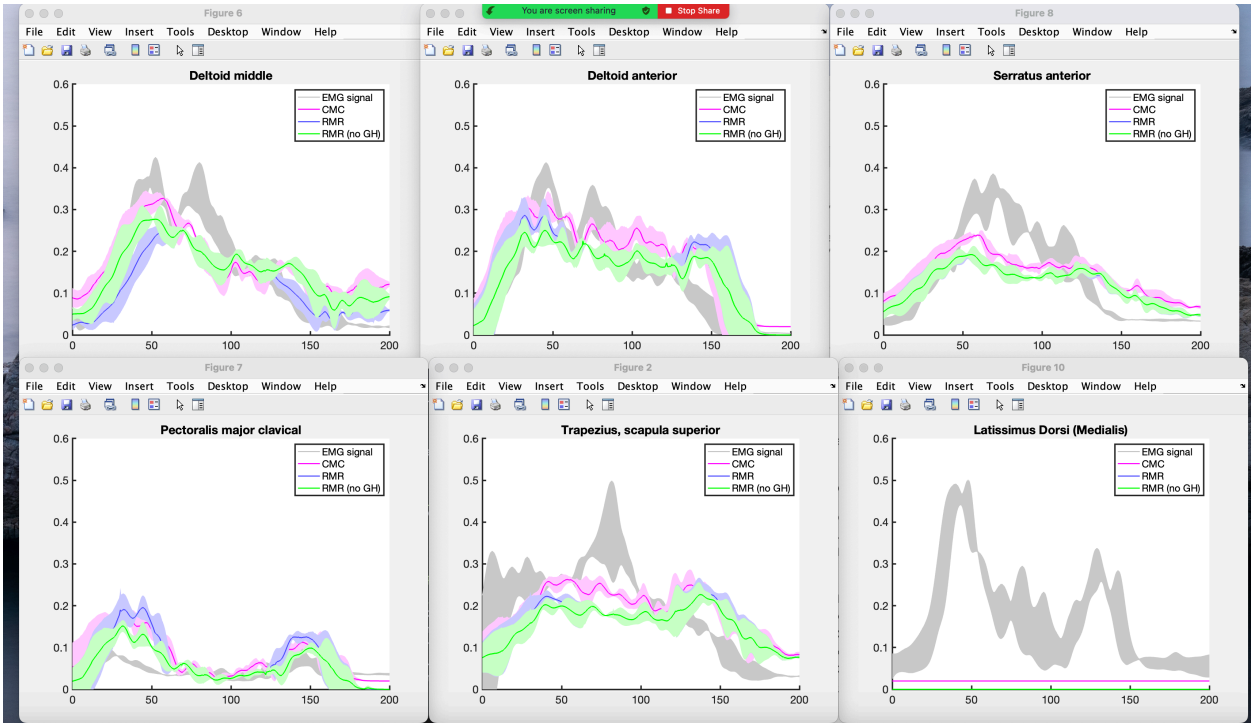
Recommendations

- Document the "Signal Processing toolbox" dependency.
- Consider portable code that works across operating systems, particularly with respect to directory separators.
- Consider whether the external data "Thoracoscapular" could be included in your repository. There are pros and cons of copying data into your repository versus asking users for an extra installation.
- Consider writing short functions that include the key parameters needed to generate results, rather than needing an interactive GUI.
- The results to generate Table 1 could be stored to a file, rather than simply printed to the terminal.

Manifest files

figure3-screenshot.png

Comment: manuscript Figure 3 (composite)



Acknowledgements

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Citing this document

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About CODECHECK

This certificate confirms that the codechecker could independently reproduce the results of a computational analysis given the data and code from a third party. A CODECHECK does not check whether the original computation analysis is correct. However, as all materials required for the reproduction are freely available by following the links in this document, the reader can then study for themselves the code and data.

About this document

This document was created using R Markdown using the `codecheck` R package. `make codecheck.pdf` will regenerate the report file.

```
sessionInfo()
```

```
## R version 4.3.1 (2023-06-16)
## Platform: aarch64-apple-darwin22.4.0 (64-bit)
## Running under: macOS Ventura 13.5.2
##
## Matrix products: default
## BLAS:   /opt/homebrew/Cellar/openblas/0.3.23/lib/libopenblasp-r0.3.23.dylib
## LAPACK: /opt/homebrew/Cellar/r/4.3.1/lib/R/lib/libRlapack.dylib;  LAPACK version 3.11.0
##
## locale:
## [1] en_GB.UTF-8/en_GB.UTF-8/en_GB.UTF-8/C/en_GB.UTF-8/en_GB.UTF-8
##
## time zone: Europe/London
## tzcode source: internal
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets
## [6] methods   base
##
## other attached packages:
##  [1] readr_2.1.3          tibble_3.1.8
##  [3] xtable_1.8-4         yaml_2.3.6
##  [5] rprojroot_2.0.3      knitr_1.41
##  [7] codecheck_0.1.0.9005 git2r_0.32.0
##  [9] parsedate_1.3.1      R.cache_0.16.0
## [11] gh_1.3.1
##
## loaded via a namespace (and not attached):
##  [1] utf8_1.2.2        generics_0.1.3    xml2_1.3.3
##  [4] stringi_1.7.12    zen4R_0.8         httpcode_0.3.0
##  [7] hms_1.1.2         digest_0.6.31     magrittr_2.0.3
## [10] evaluate_0.19     fastmap_1.1.0     R.oo_1.25.0
```

```
## [13] jsonlite_1.8.4    R.utils_2.12.2    whisker_0.4.1
## [16] DBI_1.1.3         crul_1.4.0        httr_1.4.4
## [19] purrr_1.0.0       fansi_1.0.3       cli_3.6.0
## [22] rlang_1.0.6       R.methodsS3_1.8.2 ellipsis_0.3.2
## [25] cachem_1.0.6      tools_4.3.1       tzdb_0.3.0
## [28] memoise_2.0.1     dplyr_1.0.10      curl_4.3.3
## [31] assertthat_0.2.1  vctrs_0.5.1       R6_2.5.1
## [34] lifecycle_1.0.3   stringr_1.5.0     fs_1.5.2
## [37] pkgconfig_2.0.3   rorcid_0.7.0      osfr_0.2.9
## [40] pillar_1.8.1      glue_1.6.2        xfun_0.36
## [43] tidyselect_1.2.0  keyring_1.3.1     htmltools_0.5.4
## [46] rmarkdown_2.19    compiler_4.3.1    fauxpas_0.5.2
```