Ms Resi, Compact Manual.

Mal Haysom
m.haysom@cartography.id.au

1. Disclaimer

Ms Resi is an experimental system. The authors assume no responsibility whatsoever for its use by other parties, and make no guarantees, expressed or implied, about its quality, reliability, or any other characteristic. Use of the software implies acceptance of this disclaimer.

2. Authorship

Ms Resi was initially developed at La Trobe University, Bendigo by Michelle Gibson and Mal Haysom. It is maintained by Mal Haysom. The physiological core of this software is essentially that of MacPuf, a respiratory simulation program designed at McMaster University Medical School, Canada and St. Bartholomew's Hospital Medical College. Ms Resi thus inherits the null copyright conditions of the original software (below). Ms Resi is not subject to copyright protection and is in the public domain. The authorship (Dickinson C. J. *et al*) is displayed when the program is opened.

MacPuf Copyright

"As in the case of other self-teaching simulations programmes that my colleagues and I have developed at McMaster University, University College Hospital and St. Bartholomew's Hospital Medical Colleges we have not, fortunately, been so hard pressed for financial support that we have had to restrict availability of the software to those who can help recoup the development costs, which have so far been met by our research and education budgets. We are very pleased this is so and hope it may remain so, especially so that duplication of effort in many schools can be avoided. My colleagues and I therefore make no claim to copyright of the programme itself nor of the manual examples in Appendix VII, though the remainder of the book is, of course, copyright. We trust that other users will do us the courtesy of retaining the acknowledgements of authorship and sponsorship which are incorporated in the text of the programme, in subroutine QUERY [below], and which are displayed when a user first makes acquaintance with the model."

Dickinson C. J., A Computer Model of Human Respiration, MTP Press Limited, Lancaster, 1977, p. 232

Original Authorship

"MacPuf is a model of the human respiratory system designed at McMaster University Medical School, Canada and St. Bartholomew's Hospital Medical College, England, by Dr. C. J. Dickinson, Dr. E. J .M. Campbell, Dr. A. S. Rebuck, Dr. N. L. Jones, Dr. D. Ingram and Dr. K. Ahmed. He was created to study gas transport and exchange. He contains simulated lungs, circulating blood and tissues."

Dickinson C. J., A Computer Model of Human Respiration, MTP Press Limited, Lancaster, 1977, Appendix IV, source code

Contributors

In 1981-2 Professor George Havenith, then at the Theoretical Biology Group, State University, Utrecht, The Netherlands, produced two reports [1] on MacPuf. These reports suggest adjustments and extensions to MacPuf. Where applicable these recommendations have been incorporated into Ms Resi.

Dickinson and Havenith in their respective works give attribution to many sources – some hundred and fifty references – effectively further contributors.

3. System requirements

Ms Resi has run under Microsoft Windows 98, 2000, XP and Vista.

For normal usage Ms Resi requires a 1024 X 800 pixel monitor. If the vertical dimension of the monitor exceeds 900 pixel then there is an advantage in using the maximise button to increase the size of the clinical report panel.

4. Screen presentation

On opening the program shows five panels within the main panel.

- *plot panel* (the top half of the main panel)
  – contains graph grid and scales
- *control panel* (far left, below the plot panel)
  – contains the *re-run, run, back, f'ward,* and *reset* buttons
- *passport panel* (below the control panel)
  – displays and permits entry of the fundamental subject factors
- *subject factor panel* (next to the control and passport panels)
  – displays and permits entry of subject factors and environment variables
- *display variables panel* (to the right of the above)
  – displays the physiological variables evaluated by the model

5. A walk through

Initially select *View –> About* from the main menu bar for disclaimer and background material.

The default model state on opening is a stable normal subject.

Click the run button a couple of times (or use the return key) read values from display panel or from plot using colour coded scales. These values have not changed over time because the subject is in a stable state.

Change the *Inspired O2* (in the *subject factor* panel) to 10%, click the run button a couple of times, observe that subject adjusts to new conditions. Select another display variable say *Tidal volume*; observe that the data are available retrospectively.

Now left mouse click somewhere in plot area shortly after the time where you changed the *Inspired O2* value. The cursor line shifts and the values of the variables at that time are displayed. The time is displayed. Note that *alt + left/right arrow key* provides fine movement of cursor.

Click the *re-run* button – every thing after the cursor has been wiped – you have turned back time. Now change *Inspired O2* to 22% and click the *run* button and you have started afresh.

6. Subject files

Subject files can be saved (*File->Save*) or loaded (*File->Load*). Typical use would be to create a subject with particular characteristics and to save that subject for future use. The files are text files and can be edited if desired – Appendix A, B.

7. Other

The bag section is under development.

8. References

[1] George Havenith, MacPuf report 1, MacPuf report 2, available at UCL Medical School, http://www.chime.ucl.ac.uk/resources/Models/contributions/index.shtml [accessed 17/09/2009]

Appendix A – Editing subject files

Figure 1 is an example of a subject file.

Editing rules

The first line should not be edited.

Comment lines start with a "//" marker at the extreme left and finish at the end of line. Additional comment lines can be included but are ignored by Ms Resi.

The data can be interpreted achieved with the aid of Appendix A. The data can be edited. Ms Resi is not concerned about rows and columns but expects data values to be in sequence and separated by white space.

```
// #001 Z:\temporary\ms_resi.sbj   11/07/2009 15:31:42
// these are inserted comment lines – perhaps they could describe the file, but
// they are not available via MS Resi

// height weight age  sex
    178.0  70.0  40.0  0

// subject factors
//   0       1       2       3       4       5       6       7       8       9
   3.78    0.00    0.00    0.00  300.00   37.00   -0.00  100.00  100.00  100.00
   0.00    0.00   14.80   31.00    0.40    0.03   20.93    0.00    5.00 3000.00
  35.00   45.00    0.00   13.39   12.00    0.80  760.00    3.00 3000.00  100.00
 100.00    5.00    0.00

// display variables
//   0       1       2       3       4       5       6       7       8       9
 145.76   40.09 1992.04  340.71  100.23    4.36    0.00   23.88  475.09   47.49
  40.24    0.98    7.27  195.09   19.51   92.18   96.97    7.40   47.51    0.73
  19.51    0.00    0.00   53.44  677.41   56.53   52.84   18.46   10.31   29.54
  22.70    7.33    5.02  129.63    0.00   63.19  100.00   47.39   19.63    0.78
  12.85  468.91   25.54   51.54   34.39   76.09  967.05  570.67  564.11  178.17
  14.44    7.37    6.03    2.40   71.42   25.52 1544.00   51.44   45.68  436.21
  14.53   40.09    7.37

// other variables
//   0       1       2       3       4       5       6       7       8       9
  72.67    1.00    4.60  240.00    7.40    4.00    0.00    4.25    3.31 3000.00
   0.00    6.03   45.70   -0.31  317.71    0.00    0.00   10.98    0.08  100.00


// selected subject factors
 18 20 5 0 32 -1 -1 -1

// selected display variables
 15 10 40 52 36 35 62 58

// flags and other stuff yet to be done
```

Appendix A – data recorded in subject files

Passport parameters

height weight age sex (0, female 1, male)

Subject factors

[00] 2,3-DPG concentration in red cells
[01] Addition of bicarbonate or acid, standard bicarbonate
[02] Bag CO2 percentage
[03] Bag O2 percentage
[04] Bag volume
[05] Body temperature
[06] Brain bicarbonate, deviation from normal (+/-)
[07] Breathing capacity
[08] Cardiac pump performance
[09] Central neurogenic (learnt) respiratory drive
[10] Extra anatomical right-to-left shunt
[11] Extra dead space (above normal value)
[12] Haemoglobin blood density
[13] Index of state of physical fitness
[14] Inspiratory/total breath duration ratio
[15] Inspired CO2 percentage
[16] Inspired O2 percentage
[17] Left-to-right shunt, ratio to cardiac output
[18] Lung elastance
[19] Lung volume, (end-expiration)
[20] Maximum cardiac output
[21] Packed cell volume
[22] Positive end-expiratory pressure
[23] Tissue CO2 stores
[24] Tissue ECF distribution volume
[25] Tissue respiratory quotient
[26] Total barometric pressure,
[27] Venous admixture effect
[28] Venous blood volume
[29] Ventilatory response to CO2 or H+
[30] Ventilatory response to failing partial O2
[31] Vital capacity
[32] Work Rate

Physiological variables

[00] Alveolar CO2 amount
[01] Alveolar CO2 partial
[02] Alveolar N2 amount
[03] Alveolar O2 amount
[04] Alveolar O2 partial
[05] Alveolar ventilation
[06] Arbitrary index of risk of decompression symptoms
[07] Arterial bicarbonate content
[08] Arterial CO2 amount
[09] Arterial CO2 content
[10] Arterial CO2 partial pressure
[11] Arterial lactate concentration
[12] Arterial N2 partial
[13] Arterial O2 amount
[14] Arterial O2 content
[15] Arterial O2 partial pressure
[16] Arterial O2 saturation (maximum)
[17] Arterial pH
[18] Arterial pool CO2 content of blood leaving

[19] Arterial pool N2 content of blood leaving
[20] Arterial pool O2 content of blood leaving
[21] Bag CO2 amount
[22] Bag O2 amount
[23] Brain blood flow
[24] Brain CO2 amount
[25] Brain CO2 content of blood leaving
[26] Brain CO2 partial of blood leaving
[27] Brain O2 amount
[28] Brain O2 content of blood leaving
[29] Brain O2 partial of blood leaving
[30] Brain bicarbonate content
[31] Brain pH (at putative central chemoreceptor site)
[32] Cardiac output (actual effective)
[33] Dead space (total effective physiological)
[34] Excess N2 held above normal maximum saturation
[35] Heart rate
[36] Metabolic rate
[37] Pulmonary capillary (idealized) blood CO2 content
[38] Pulmonary capillary (idealized) blood O2 content
[39] Respiratory quotient
[40] Respiratory rate
[41] Tidal volume
[42] Tissue bicarbonate content of blood leaving
[43] Tissue CO2 content of blood leaving
[44] Tissue lactate amount (body total)
[45] Tissue N2 amount in ‘fast’ compartment
[46] Tissue N2 amount in ‘slow’ compartment
[47] Tissue N2 partial in ‘fast’ compartment
[48] Tissue N2 partial in ‘slow’ compartment
[49] Tissue O2 amount
[50] Tissue O2 content of blood leaving
[51] Tissue pH
[52] Total ventilation
[53] Venous admixture (total effective)
[54] Venous bicarbonate amount
[55] Venous bicarbonate content (mixed venous)
[56] Venous CO2 amount
[57] Venous CO2 content (blood in pulmonary artery)
[58] Venous CO2 partial
[59] Venous O2 amount
[60] Venous O2 content of blood in pulmonary artery
[61] Venous O2 partial (approx. values - time shifted)
[62] Venous pH (of mixed venous blood)

Other variables

[00] Alveolar ventilation
[01] Index of brain oxygenation adequacy
[02] Nominal resting cardiac output
[03] Tissue O2 consumption, nominal resting value
[04] Arterial H+ activity (at end of each iteration)
[05] Forced expired volume
[06] Index of time brain has been deprived of oxygen
[07] Nett O2 uptake per iteration
[08] Nett CO2 uptake per iteration
[09] Reference volume of lungs
[10] Extra shunt effect for emphysematous subjects
[11] Total effective ventilatory drive
[12] Reference value detecting CO2 partial pressure
[13] Tissue bicarbonate adjusted

[14] Tissue bicarbonate amount
[15] Extra dead space for altered function tests
[16] Local lactate concentration
[17] Damping function respiratory drive
[18] Heart stroke volume
[19] Arterial

selected subject factors
Positive values represent the factor to be displayed, for example an 8 will result in the display of *Cardiac pump performance*. A -1 entry results in a blank display.

selected display variables
Positive values represent the factor to be displayed, for example an 8 will result in the display of *Arterial CO2 amount*. A 63 entry results in a blank display.