

Physiological and Anatomical Visual Analytics Server-Side Application

PAVA
Version 1.0

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Disclaimer

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This Server-Side application (SSA), PAVA (physiological and Anatomical Visual Analytics) v1.0, is a anatomical and physiological visualization tool for physiologically annotated data. It is accessible through Firefox/Mozilla and Safari browsers upon successful installation on a linux server running both APACHE web-daemon and ImageMagick, both open-access packages available under the GNU public license and commonly distributed with major linux distributions, such as RedHat linux.

All models visualized through the use of this tool are models that reside with the respective end-users/modelers. The source-code is provided (i.e.PERL/CGI and html scripts) and may be modified by the end-user under the condition that the original authors and source of this code be added as comments/references to the code (see citation below).

Output generated by the code may be used in public or private communications and publications, for personal, research or business related purposes provided that the accompanying citation is clearly added to the generated images/animations.

Citation: (a) Goldsmith, M.-R.; Transue T. R.; Chang, D. T.; Tornero-Velez R.; Breen, M.S.; Dary, C. C.; "Physiological and Anatomical Visual Analytics for mapping of tissue-specific concentration and time-course data" *Journal Of Pharmacokinetics and Pharmacodynamics*, **2010**. Manuscript in press. (b) <http://epa.gov/heasd/products/pava/pava.html>

Installation Requirements and Instructions for PAVA Server-Side Application on a Linux Server

User Requirements:

- Understanding of basic linux commands, including but not limited to starting a web-daemon using Apache, and root access for installation.

Computer requirements:

- Linux operating system (macintosh OS X may be o.k., but will require ImageMagick, <http://www.imagemagick.org/script/download.php>)
- Apache web server (version probably does not matter) with access to web and cgi space
- PERL (version 5 or later is probably fine)
- ImageMagick Suite including “convert” and “composite”

Files:

- Zip file *pava_cgi.zip* which contains the directory *pava_cgi* which contains PERL scripts:
 - [show.cgi](#)
 - [animate.cgi](#)
- Zip file *pava_web.zip* which contains the directory *pava_web* which contains html, js, css, and image files:
 - [index.html](#)
 - [script.js](#)
 - [style.css](#)
 - [show.js](#)
 - *results* directory (for output animation: *animation.gif*)
 - *organs* directory (containing standard, thumb, and template organ images)

Instructions:

- Unzip *pava_cgi.zip* and place the resulting directory *pava_cgi* in the Apache cgi space. In Redhat linux, for example, the default cgi space is /var/www/cgi-bin.
- Be sure that Apache cgi functionality is turned on and *show.cgi* and *animate.cgi* are world executable (e.g. use “chmod 755”).
- Unzip *pava_web.zip* and place the resulting directory *pava_web* in the Apache web space. In Redhat linux, for example, the default web space is /var/www/html or ~user/public_html.
- In the *pava_cgi* directory , edit *show.cgi* to set the CGI and WEB paths correctly. Search for the text: *CONFIG* and edit the lines below.
- In the *pava_cgi* directory , edit *animate.cgi* to set the WEB path and file system path to the web space correctly. Search for the text: *CONFIG* and edit the 2 lines below.
- In the *pava_web* space, edit *index.html* to set the CGI-BIN path correctly. Search for the text: *CONFIG* and edit the line below using the instructions below that line.
- Open the PAVA viewer at http://your.host.ip/pava_web where *your.host.ip* is your host ip address, and *pava_web* is the path to your pava viewer.

PAVA Installation Troubleshooting:

- I do not see a human figure in the pava viewer first page – Either permissions or paths are not set correctly for *index.html* to access the *organs* directory and subdirectories.
- Clicking the names organs does not result in organs moving to the right “selected” side and appearing in the figure – Browser compatibility issue, a recent version of Firefox is recommended.

PAVA 6-STEP Quick-Start Guide

Including demonstration: Rendering PBPK model output

- 1) Enter the URL of the installed PAVA script
- 2) select the **gender** according to simulation or experimental information, select appropriate **time intervals** and **units**, and **select the organs** for which you have temporal data (for instance concentration time-curves, or year-specific disease morbidity / mortality data, or life-stage specific gene-expression data). When selecting organs, if you have incorrectly annotated the wrong organ to the wrong table, the arrows in the Organ selection panel can change the order. An example we have provided is the output from an ethanol PBPK model for a male, that includes 6 organs: Liver, Kidney, Heart, Muscle, Skin, Lung.
- 3) **If the data** you are copying has organs or physiologically annotated data as column fields, and temporal (time) data as rows, you will need to copy this data into the TEXT box” **and subsequently select “Transpose”** button. **If the data is** already row-organ, column-time data, it can be **copied/pasted without** the additional transpose step.
(**For demo (see page 2):** *In our case we have data that includes organs column fields and each row is a time-point. Each time point was 1.72 minutes apart over the period of 300 minutes. One would select Time: minutes, interval = 1.72, Starting point = 0, Male, and after having copied the data, must select “Transpose” to get Row formatted.*)
- 4) GO will execute the “Data matrix representation” format that will open a NEW TAB and will provide an anatomical view of organs represented in the model, in addition to an Organ * time point (i.e. row * column) matrix where each element has been colored according to the maximum positive, or negative value, normalized over a blue, white, red color scheme. The **color scheme can be adjusted** by entering a desired number into the legend. (**Note:** *If this page has been rendered in error, close this tab and return to the main PAVA page to complete organ selection, etc...*)
- 5) From the data representation view an animation can be rendered, where the number of seconds of animation (Sec) , and the frames-per-second (FPS) are entered to generate Sec * FPS framed animation. This process calls upon image-magick to generate the individual frames and aggregate them into an animated GIF which is subsequently displayed on screen when the entire process is complete. **NOTE:** the more frames and organs you generate, the more complex the render process is, the longer it will take.
- 6) The complete image can be copied (right-click and save-as feature, rename to optional FILENAME.gif) and saved as an animated GIF file, which can be imported into other documents (HTML, MS-WORD, MS-PowerPoint) as desired.

- **SEE DEMO FOR MODEL OUTPUT ON PAGE 3, AND**
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- **ADDITIONAL SAMPLE DATA ON PAGES 4-6.**
- **SEE PAVA USAGE FAQs ON INPUT FORMAT ON PAGE 9**

DEMO: Sample test-data for an ethyl alcohol PBPK model output is being supplied

Gender: **Male** Time start = **0** minutes, Time interval = **1.72** minutes, Time unit = **minutes**
Organ selection:

Liver, Kidney, Heart, Muscle, Skin, lung

Data:

(each column is the concentration , i.e. parts-per whatever, g/ml, mg/kg, mol/L etc...)

Note:

A) Select the "GENDER"

B) Select the "ORGANS"

C) Select the time interval of your simulation, the starting time, the end time and the units...for this example we started at time 0 minutes and worked up to 300 minutes with 1.72 minute intervals

D) Copy the Organ-specific concentration/time profiles listed below (below D).

NOTE: since the ORGANS ARE LISTED AS COLUMNS **you will need to select the Transpose button** to transpose the array so that organ specific information is row-delimited.

E) selecting "Go" or hitting enter will open an additional Tab window with the matrix representation.

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0.032151346 0.270250895 0.27305179 0.65221032 0.304363576 0.269531815
0.031281444 0.264524397 0.266289933 0.635454559 0.296608677 0.264969629
0.030229572 0.257108469 0.259720697 0.619826491 0.289354343 0.256478579
0.029282964 0.250454028 0.253374491 0.604532835 0.282274606 0.249392396
0.028432176 0.244466346 0.247096047 0.589176334 0.275185889 0.243688007
0.027579278 0.238384379 0.241053107 0.57450063 0.268413781 0.237498342
0.026797882 0.232731948 0.235120958 0.559970716 0.261721917 0.232120346
0.026138729 0.227839673 0.229356866 0.545628385 0.255133731 0.228212257
0.025272633 0.221540116 0.223754319 0.532239364 0.248961487 0.22102354
0.024781651 0.217888454 0.220097438 0.523331139 0.244866003 0.217341778

PAVA USAGE FAQs

Q: Can you upload a data file into PAVA?

A: No, currently the feature to do this is only cut/paste options from whatever standard physiologically annotated data output (for instance PBPK model output text files) and paste into the text area. This feature should become available in future versions/releases.

Q: My first column of output is time, not concentration. What should I do?

A: If your first column is concentration take note of the starting time (i.e. 0 sec, 0 minutes, etc....) and time interval used between rows (and units) and enter this data accordingly into the main PAVA page. Then delete that column.

Q: I would like to be able to adjust the contrast of the color map scheme used, how do I do this?

A: On the Physiological Matrix representation (color grid) there is a Min, median and Max dose for which color gradients can be adjusted manually by clicking on the highest current value (default normalization color) and entering an alternate color and deselecting the box will automatically adjust the color map. This scheme should carry through to the animation as well.