



Novel analytic methods to estimate physical activity from accelerometer data: an open-source web-based tool

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INTRODUCTION

- Clinical researchers frequently use accelerometers to objectively measure physical activity. The Actigraph GT3X accelerometer is a model that measures acceleration along the vertical axis and records it in counts per unit time (e.g., counts per second). (A count is a measure of the amount of acceleration experienced by the device.)
- Sophisticated statistical techniques have been developed to use recorded counts from an individual wearing an accelerometer to estimate energy expenditure by that individual in terms of the physiologically meaningful unit of METs.
- Implementing these statistical methods involves substantial computer programming. This poses a barrier to the use of these methods by clinical researchers.

PURPOSE

The purpose of this project was to create a free and open source website allowing researchers to easily use several statistical models to estimate energy expenditure using recorded counts per second from an accelerometer.

USING THE WEBSITE - INPUT

There are three main sections of the web page:

1. Select files for analysis: The site accepts 1-second epoch vertical acceleration Actigraph GT3X accelerometer .csv files. To upload multiple files, click the "Add Another File" button. A forthcoming version will allow simultaneous selection of multiple files.

2. Select statistical methods to use: Four methods are available: the "sojourn" Neural Network (Staudenmayer et al³), the 2-regression method (Crouter et al¹), Freedson et al's linear regression², or another linear regression model with user defined cutpoints for 3 METs and 6 METs.

3. Select other options and settings:

- If there is an on/off record indicating the times of day that the accelerometers in uploaded data files were on and off, upload it here. Otherwise, specify tolerance levels for activity and inactivity which will be used to automatically generate an on/off record.
- The user can also specify intervals within each day for which separate estimates should be made.

USING THE WEBSITE - OUTPUT

When the analysis is complete, the web page displays links to spreadsheets with the results. Between 1 and 3 spreadsheets will be created, depending on the options selected.

1. session#-results.csv: This file is always created. The spreadsheet contains a row for each calendar day covered by each uploaded Actigraph data file. The spreadsheet has the following columns:

- The subject and visit identifiers, the date, and whether that date was a weekday or weekend day.
- The number of hours the Actigraph was on, from the on/off record that was uploaded or generated automatically.
- For each selected statistical method, the following estimated quantities: MET hours; number of minutes spent in minimal, light, moderate, and vigorous activity; number of bouts (i.e., periods of at least 10 consecutive minutes of moderate activity with up to 2 minutes of less than moderate activity); number of MET hours that occurred during a bout; and number of transitions from a minimal activity level to a higher than minimal activity level.
- If the neural network method was used, estimates of the number of minutes spent in each of four activity types: minimal, locomotive, vigorous sport, and housework.

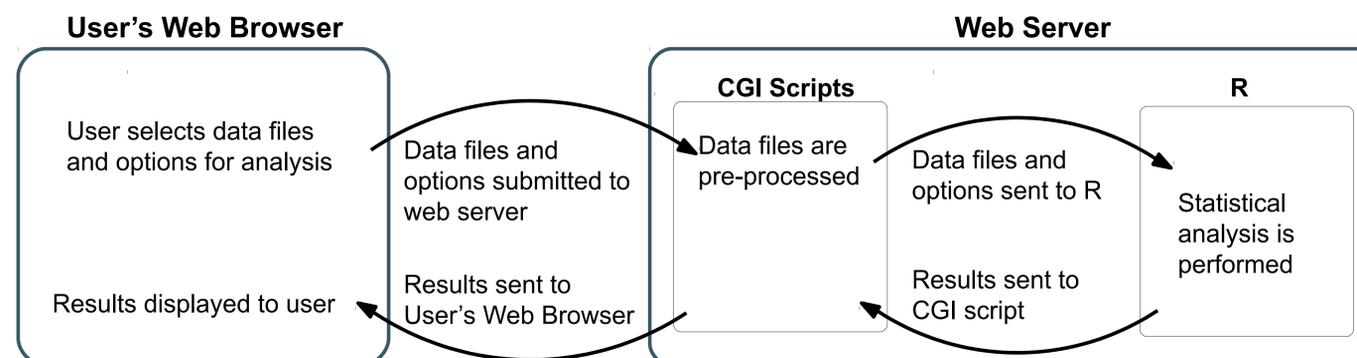
	A	B	C	D	E	F	G	H	I	J	K	L	M	
1	subject	visit	day	weekday	hours.on	nnet.METHrs	nnet.minimal.min	nnet.light.min	nnet.moderate.min	nnet.vigorous.min	nnet.min.act.min	nnet.locomot.act.min	nnet.vigsp.act.min	
2	AG05B	1	4/14/2010	weekday	14.42222222	33.44566728		541	150.8833333	139.15	68.96666667	541.5	269.2833333	9.2

2. session#-intervalresults.csv: This file is created if the user specified intervals to be analyzed separately within each day. This spreadsheet contains the same columns as the main session#-results.csv file, but has separate estimated values for each interval within each day covered by the uploaded Actigraph data files.

3. session#-onrecord.csv: This file is created if an on/off record was not uploaded. It contains the automatically generated on/off record indicating estimated times the accelerometer was on and off for each uploaded file.

TECHNICAL IMPLEMENTATION

The website has two major components: the user interface, where the user interacts with the application, and the web server, where statistical computations are performed. We created the user interface using HTML, CSS, and JavaScript, and wrote the statistical procedures in the R statistical computing language. A set of common gateway interface (CGI) scripts (written in Perl) on the server is used to connect the user interface with R.



REFERENCES

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