

WAAAG Documentation – Version 1.1

Description

Walking Ability At A Glance (WAAAG) is a replacement for GAMS which was previously used to determine the representative gait cycle, to calculate average rotations, to generate plots and tables of temporal-spatial walking parameters and GDI, and to obtain the average kinematic rotations. WAAAG is a command-line function within MATLAB, allowing for simpler processing compared to GAMS which used a GUI. In addition, WAAAG can process up to 4 conditions simultaneously: Current, AFO, Last, and Extra slots, all of which can be renamed for the graphical and table outputs. WAAAG can be used in place of miniGAMS for any/all conditions. WAAAG data is automatically saved (WAAAG_data.mat) so the computations can always be double checked and used elsewhere (full kinematics processing - PlotKinematics). WAAAG is not currently supported for Score_Sara C3Ds.

WAAAG uses many of the functions that GAMS did, some edited for brevity and speed. In addition, it uses code from GetKinematics.m, so some background info can be edited in the Selector File excel spreadsheet. One major change from GAMS to WAAAG is that the Hemiplegic side is no longer needed/used to determine the representative trial. WAAAG will determine the representative trial by the lowest average kinematics RMS difference between that trial and the ensemble average computed across all included trials. GAMS selected the rep trial based on the Hemi side with the lowest RMS difference.

Version 1.1: Updates in this version include:

1. reversing the bars and dots so that the average is shown by the bars and the rep trial is shown by a dot
2. reorganizing the plots so that stride length is also included in main temporal spatial plots GDI plot will now be included in a separate graph that also contains a movement analysis profile (MAP) - see Baker et al. 2009. Gait & Posture. 30 (3): 265-269 for more info <doi:10.1016/j.gaitpost.2009.05.020>
3. added trial and cycle count metrics to the excel spreadsheet (next to Average Rotations)
4. updated image file type to PNG for simpler pasting into EPIC
5. changed to automatic excel copying and saving - no need to copy the template and rename
6. added lists of the representative trials for each condition to the main excel page
7. version # and date processed on excel spreadsheet

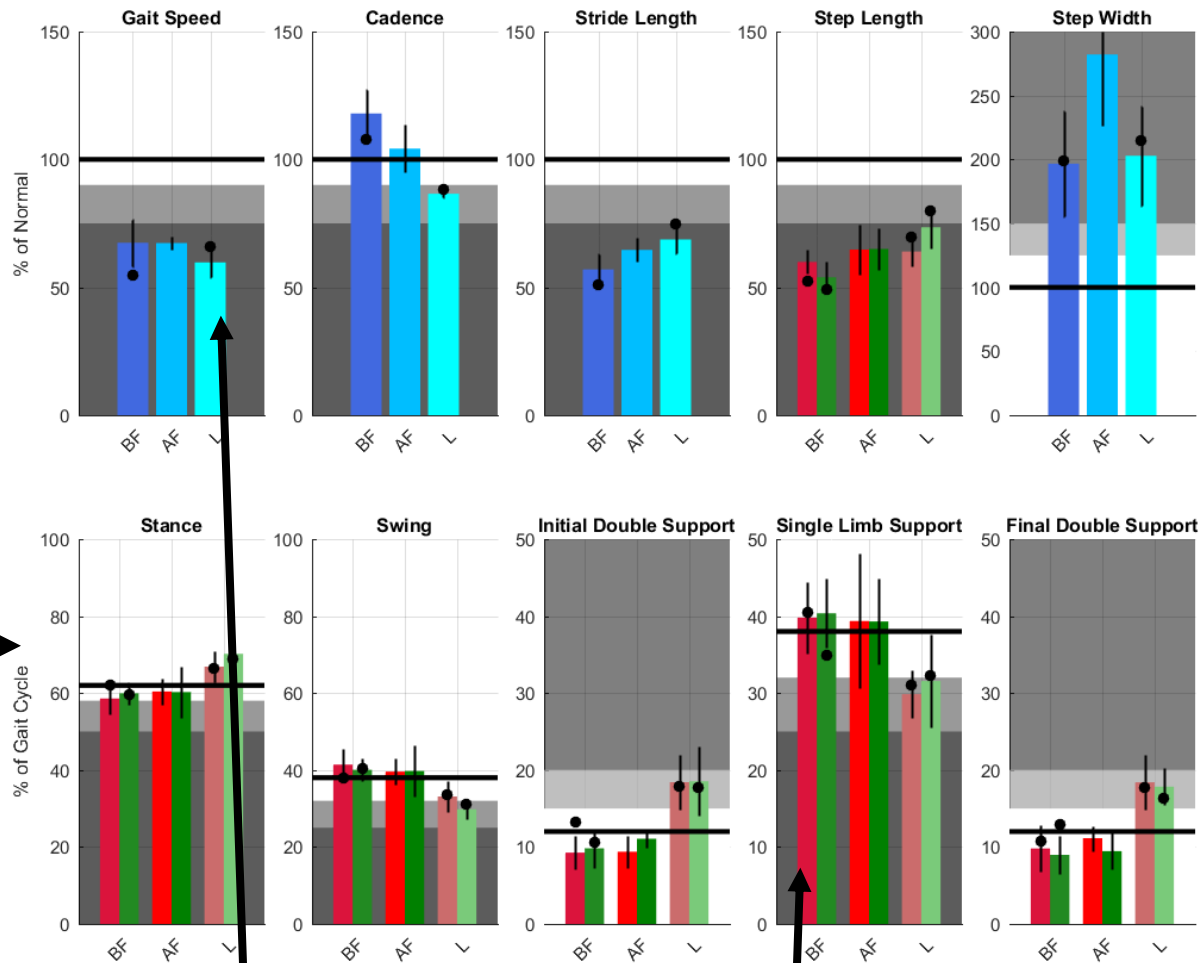
Instructions

1. For the new user, copy the WAAAG folder from S:\cgma_TechOps\Software\Matlab Programs\Deployed into your MATLAB folder
2. Copy the C3D files to be used into your MATLAB path or within the WAAAG folder
3. Open MATLAB and run WAAAG
4. Input the age of the subject – age is used for the comparisons to reference as “% of reference”
5. Determine how you would like to name the current condition
6. Select the type of C3D files: full kinematics or Temp-spat only for foot markers only
7. Select the processed C3D files for the current condition. There is no limit to the number you can select, however more files mean longer processing time
8. Determine if you would like to add any additional conditions. Follow same instructions as above.
9. All of these conditions can be renamed for the graphical outputs
10. You will now find new files in your WAAAG folder including:
 - a. WAAAG_data.mat – all outputs, selections, and inputs from running the Code. This may or may not be useful to the average user, but contains a plethora of gait-related information.
 - b. Ave_Rotations.gcd and any other GCD files depending on the conditions selected (AFO_Rotations, Last_Rotations, Extra_Rotations). These are ready for input into Polygon.
 - c. GaitMeasures.png – a saved plot of the temporal spatial parameters, referenced to normal
 - d. GDI-MAP.png – a saved plot of the GDI and MAP scores. See details below
 - e. WAAAG.xls spreadsheet – this contains descriptions of the rep trial, rep cycles, type of input, values for all the gait measures metrics, Ranking of trials and cycles, and the average rotations for each condition. Be sure to check out the multiple sheets.

Gait Measures

This plot has changed since version 1. Now the bars represent the average metrics, the error bars represent the standard deviation, plotted above and below the mean, and the dot signifies the value for the representative cycle (calculated using kinematics). The error bars may look somewhat different if an older version of matlab is used. If the condition is a foot-marker only, there will be no dots for that condition. Also, GDI has been removed from this figure, and stride length has been added in its place.

The values used for this figure come from every trial (i.e. there is a measure for each trial). If only 1 trial is imported, there will be no error bars, and the dot will be the same as the bar.



2. The bottom row presents all data as % of gait cycle

3. The blue bars represent 1-sided metrics

4. The red and green bars represent 2-sided metrics. Red = right, green = left

5. The horizontal line represents the target, which for WAAAG represents the age-matched reference metric (% of normal)

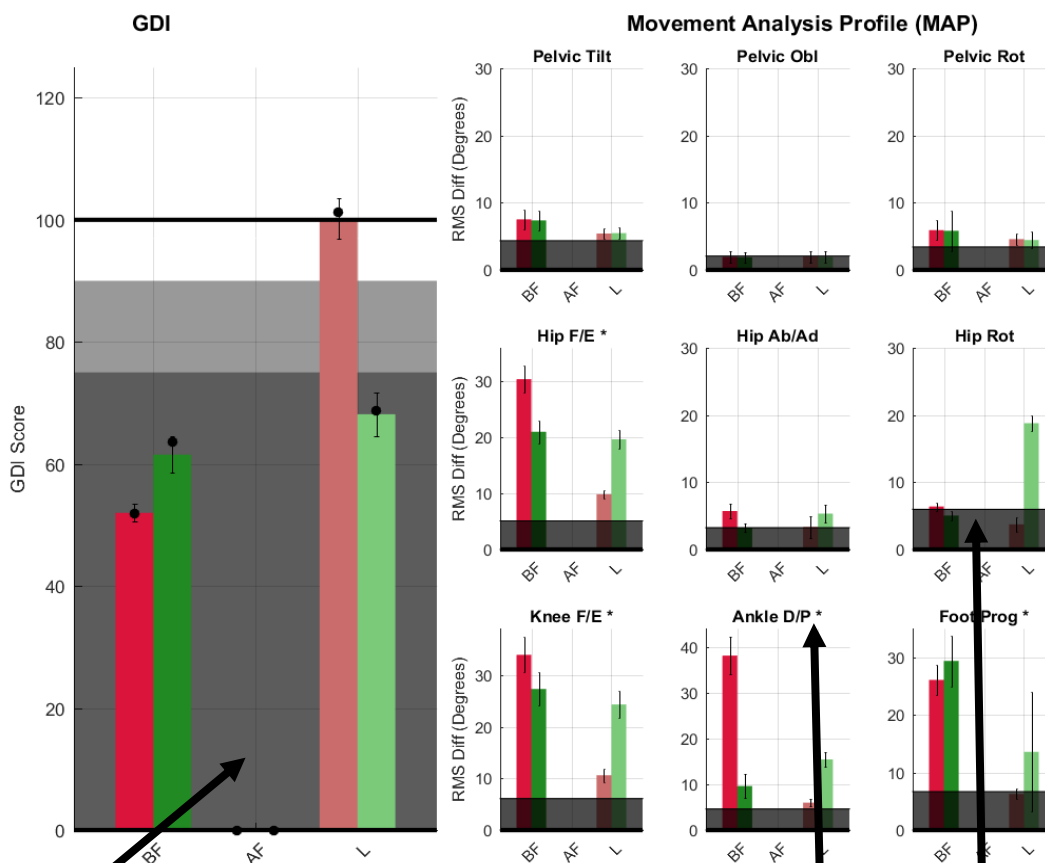
1. The top row presents all data as % of reference/normal

6. The various shaded regions display the areas of good, ok, and poor measurements. For instance, in this case, step width is considered good if it is <125% of normal (in the white region), ok if it is between 125-150% (light gray), and poor if >150% (dark gray).

GDI and Movement Analysis Profile

This is a new plot for WAAAG version 1.1. The left side of this plot shows the GDI score(s) for each condition. In this case, there are no scores for the AF condition because the trials were foot markers only. Like the gait measures plots, the bar represents the average, error bar for the standard deviation, and dot as the representative cycle. All of the values used for this plot were calculated for each gait cycle of each trial for the condition, thus anywhere from 5-50+ cycles may be included for the averages and standard deviations on this plot.

The right side of the plot shows a modified version of the movement analysis profile (MAP). The goal of the MAP is to show which joints/planes of kinematics affect the GDI score the most by showing the RMS difference of the kinematics from the reference data, averaged over the whole gait cycle. The shaded regions show the deviation that occurs in the normal population. This can be thought of as one half of the gray band in the kinematic graphs. If the bars are higher than the gray band, then the subject's kinematics deviate from the norm by more than 1 standard deviation. Taller bars indicate further deviation. For more information on MAP: <https://www.ncbi.nlm.nih.gov/pubmed/19632117>



1. No GDI values for a condition indicate that full kinematics were not collected for that condition.

2. An asterisk by the plot title indicates that the range has been adjusted from the default 30 degrees to show greater deviation.

3. If the bars are below the gray band, then the subject's kinematics are less than 1 standard deviation from the norm

WAAAG Excel Spreadsheet

Below are screen shots of the WAAAG Excel Output. The top section lists the representative trials and cycles for each condition, unless full kinematics were not captured. Subject age, processing date, and version # are included in the top right corner. The next section displays the averages for the reference population and all conditions. These averages are calculated from each trial (1 value per trial). The 3rd section shows the average rotations for all full kinematic conditions, and also displays the trial and cycle count on the right. The # of full cycles only count the cycles that have both left and right sides, so if there are 6 lefts and 7 rights, there are 6 full cycles. The final section shows the standard deviation for each of the metrics. There are no reference values for this.

	Representative Trial(s)		Left Rep Cycle	Right Rep Cycle		Trial Type				Subject Age			19-Jan-18	Version 1.1	
BF	A3799 BF 07.c3d		4	4		Full Kinematics				9					
AFO			0	0		Temp-Spat Only							IDS = Initial Double Support		
Shod	AMN01702 PiG.c3d		3	3		Full Kinematics							SS = Single Limb Support		
													FDS = Final Double Limb Support		
AVERAGES	Cadence	Stride Length	Walking Speed	GDI - Left	GDI - Right	L Step Length	R Step Length	Step Width	Stance Period	Swing Period	IDS	SS	FDS		
Units	steps/min	m	m/min	N/A	N/A	cm	cm	cm	% Gait Cycle	% Gait Cycle	% Gait Cycle	% Gait Cycle	% Gait Cycle		
Reference	132.96	1.15	70.44	100.00	100.00	53.00	53.00	7.97	62.00	38.00	12.00	38.00	12.00		
BF	148.63	0.64	47.69	51.85	63.53	33.70	30.14	15.60	59.68	40.32	10.06	39.48	9.83		
AFO	132.32	0.76	50.01	0.00	0.00	37.86	38.03	23.06	60.32	39.68	10.22	39.33	10.30		
Shod	101.81	1.29	65.69	85.08	73.70	63.36	65.69	11.36	60.60	39.40	10.33	39.28	10.05		
Average Rotations (degrees)									Trial and Cycle Count						
	BF		Left	Right	Left	Right	Shod		Left	Right	BF	# Trials	# L Cycles	# R Cycles	# Full Cycles
Pelvis	-3.44	4.10					3.01	-2.99	AFO	4	18	18	18	18	
Hip	6.52	4.26					5.22	21.85	Shod	5	15	19	15	15	
Knee	-5.01	1.55					13.54	12.50							
Ankle	16.11	23.39					18.75	8.11							
Foot Prog	24.22	26.87					7.15	5.00							
ST DEVS	Cadence	Stride Length	Walking Speed	GDI - Left	GDI - Right	L Step Length	R Step Length	Step Width	Stance Period	Swing Period	IDS	SS	FDS		
Units	steps/min	m	m/min	N/A	N/A	cm	cm	cm	% Gait Cycle	% Gait Cycle	% Gait Cycle	% Gait Cycle	% Gait Cycle		
BF	13.14	0.05	6.64	0.00	0.00	2.74	3.46	3.43	3.54	3.54	2.57	4.91	2.94		
AFO	11.18	0.05	1.55	0.00		5.35	4.52	4.50	4.62	4.62	1.42	7.00	1.84		
Shod	2.88	0.01	1.83	0.00	0.00	2.91	2.42	3.36	1.04	1.04	1.76	2.21	1.07		

The Trial and Cycle selections spreadsheet shows a breakdown for the rankings of trials and cycles closest to the ensemble average. The left side displays the names and kinematic residuals for all the trials. The one with the lowest average residual is the rep trial and is highlighted in green. The 2nd and 3rd ranked trials are also highlighted. The cycle rankings for these 3 trials are then displayed on the right portion of the sheet. This spreadsheet is mainly useful for the gait lab engineer when selecting the representative trial and looking for clean kinetics.

[illegible]