WAAAG Documentation – Version 2

Description

Walking Ability At A Glance (WAAAG) calculates and displays various measures of a person's gait pattern. WAAAG is 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 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 for temporal spatial analysis among any/all conditions (heel & toe markers only). WAAAG data is automatically saved so the computations can always be double checked, and the data can be used elsewhere.

Version 2 updates include:

1. New processing via ProcessC3D
    a. Temporal spatial parameters now calculated for every gait cycle
2. Use of an excel file to select various input parameters
3. New temporal-spatial norms
    a. standard deviations now used in the temporal-spatial figure
4. Score Sara functionality
5. Ankle dorsi/plantar flexion and knee AB/AD average rotation
    a. currently commented out due to plotting discrepancies in polygon (plots thicker than other lines)
    b. uncomment the following lines to export ankle dorsi/plantarflexion and knee AB/AD average rots
        i. 2810-2813
        ii. 2845-2848
        iii. 2881-2884
        iv. 2916-2919

Instructions

1. For the new user, copy the WAAAG V2 folder from 'S:\cgma_TechOps\Software\Matlab Programs\Deployed\WAAAG' into your MATLAB folder
2. Copy desired C3D files into the WAAAG folder
3. Open the 'Processing_Selection.xlsx' spreadsheet and select your desired processing scheme
    a. See the WAAAG processing options to further accelerate processing time (optional)
4. Open MATLAB, run WAAAG, and follow any input prompts (number of required inputs depends on processing scheme)
5. You will now find the following in a new folder:
    a. The folder will be named in the first line of the Processing_Selections spreadsheet
    b. *WAAAG_data.mat* – all outputs, selections, and inputs from running WAAAG
    a. *Ave_Rotations.gcd* – and any other GCD files depending on the conditions selected *(AFO_Ave_Rotations, Last_ Ave_Rotations, Extra_ Ave_Rotations).* These are ready for input into Polygon.
    b. *GaitMeasures.png* – a saved plot of the temporal spatial parameters, referenced to normal
    c. *GDI-MAP.png* – a saved plot of the GDI and MAP scores. See details below
    d. *WAAAG.xlsx* – 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.
    e. *Optional outputs*
        i. Kinematic Plots (png file) – plot of gait-cycle parsed kinematics depending on input selections. See the Processing Selections spreadsheet for more info

Detailed Description of Updates

Excel File to define Processing Selections

By defining processing selections and inputs prior to running WAAAG, processing time can be shortened and automated. Use the series of drop downs and blanks to define subject parameters, kinematics data processing selections, plotting options, and WAAAG conditions. Below is an example.

WAAAG Processing Selections

For use by SelectOptions Matlab Code

Input	Value	Description
Subject Specific Info		
Study Name/Number	Full	for creating a new folder that contains all outputs and data
Use MP File	No	Option to use the nexus .mp file for body dimensions and anthros
Age (yrs)	12	type in value, rounded to integer (1)
Height (m)		type in value, rounded to hundredths (1.11) - Optional
Mass (kg)		type in value, rounded to tenths (1.1) - Optional
Kinematics Data Processing Options		
Gait Trial	Yes	Is or is not a gait trial
Marker Set Type	lowerbody	type of markerset used in data collection
Delete First Gait Cycle	No	omit first gait cycle for each side
GDI RC or EA	RC	Display GDI from ensemble average or rep cycle
Kinematics Plotting Options		
Plot Kinematics	No	Option to plot kinematics
Plot Type	lowerbody	Lowerbody= 12, torso = 15
Footstrike	Yes	include foot strike timing bars in plots
Plot RC or EA	RC	plot the representative cycle or ensemble average as the main plot
Standard Deviation	No	Include standard deviation bands in plot
Control Data	Yes	Plot control kinematics along with curve - must specify age
Second Curve	No	Include a second curve to plot along with main curve - will be dashed
Average Rotations	Yes	plot average rotations along with other data
Plot All Cycles	No	Plots all cycles in all trials
Kinetics Data Processing Options		
Kinetics Plotting Options		
WAAAG Processing Options		
Use these settings	Yes	If yes, will use the info below. If no, WAAAG will prompt info in dialog boxes.
Current Condition Name	Curr	type in value
Current Condition Type	Full Kinemat	Full Kinematics (model needed) or foot only markers for temporal spatial measures
AFO Condition	Yes	Yes/No to include this condition
AFO Condition Name	AFO	type in value
AFO Condition Type	Full Kinemat	Full Kinematics (model needed) or foot only markers for temporal spatial measures
Last Condition	No	Yes/No to include this condition
Last Condition Name		type in value
Last Condition Type		Full Kinematics (model needed) or foot only markers for temporal spatial measures
Extra Condition	No	Yes/No to include this condition
Extra Condition Name		type in value
Extra Condition Type		Full Kinematics (model needed) or foot only markers for temporal spatial measures
END		

ProcessC3D info

ProcessC3D functionality is a totally new data processing software, compared to WAAAG V1 or GAMS. This upgrade includes many additional features including:

- Ability to plot kinematic curves if desired
- Display of current trial being loaded – to identify the trial with missed gait events or bad data
- temporal-spatial data for each gait cycle of each trial
- raw and parsed kinematic data
- data saved in structure format for simple navigation
- Can also be used for normal database processing or compiling many C3Ds together

Structure organization makes it easy to find the data you need.

FullFileName	HeaderInfo	Trajectories	Events	Kinematics	Kinetics	Direction	TempSpat	Aggregate	TrialsGDI	KineMatrix
'C3947 AFO 01.c...	*1x14 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	'South'	*1x12 struct*	*1x1 struct*	*16x3 double*	*101x24x16 do...*
'C3947 AFO 02G...	*1x14 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	'North'	*1x12 struct*	[]	[]	[]
'C3947 AFO 05.c...	*1x14 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	*1x1 struct*	'North'	*1x12 struct*	[]	[]	[]

Aggregate data shows metrics from all trails – rep trial, rep cycles, GDI scores, ensemble averages, and settings.

KineData(1).Aggregate

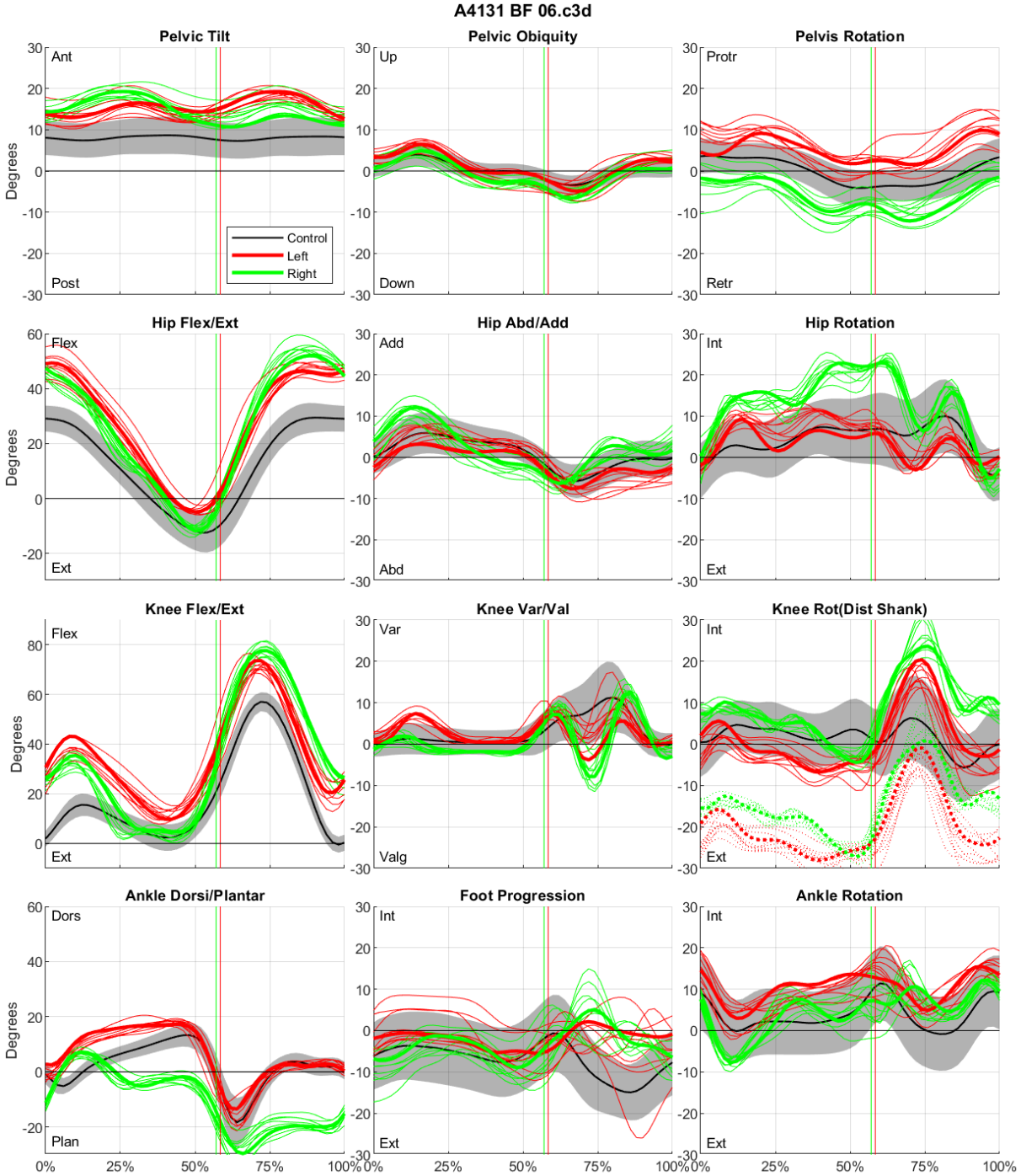
Field	Value
AllCycles	*101x36x10 double*
CyclesRegistry	*10x2 double*
EnsembleAverage	*101x36 double*
StandardDev	*101x36 double*
RepTrial	3
TrialRanks	[1,3;2,2;3,1;4,4;5,5]
RepCycRank	[2,1]
GDI	*1x1 struct*
RepCycle	*101x36 double*
Settings	*1x1 struct*

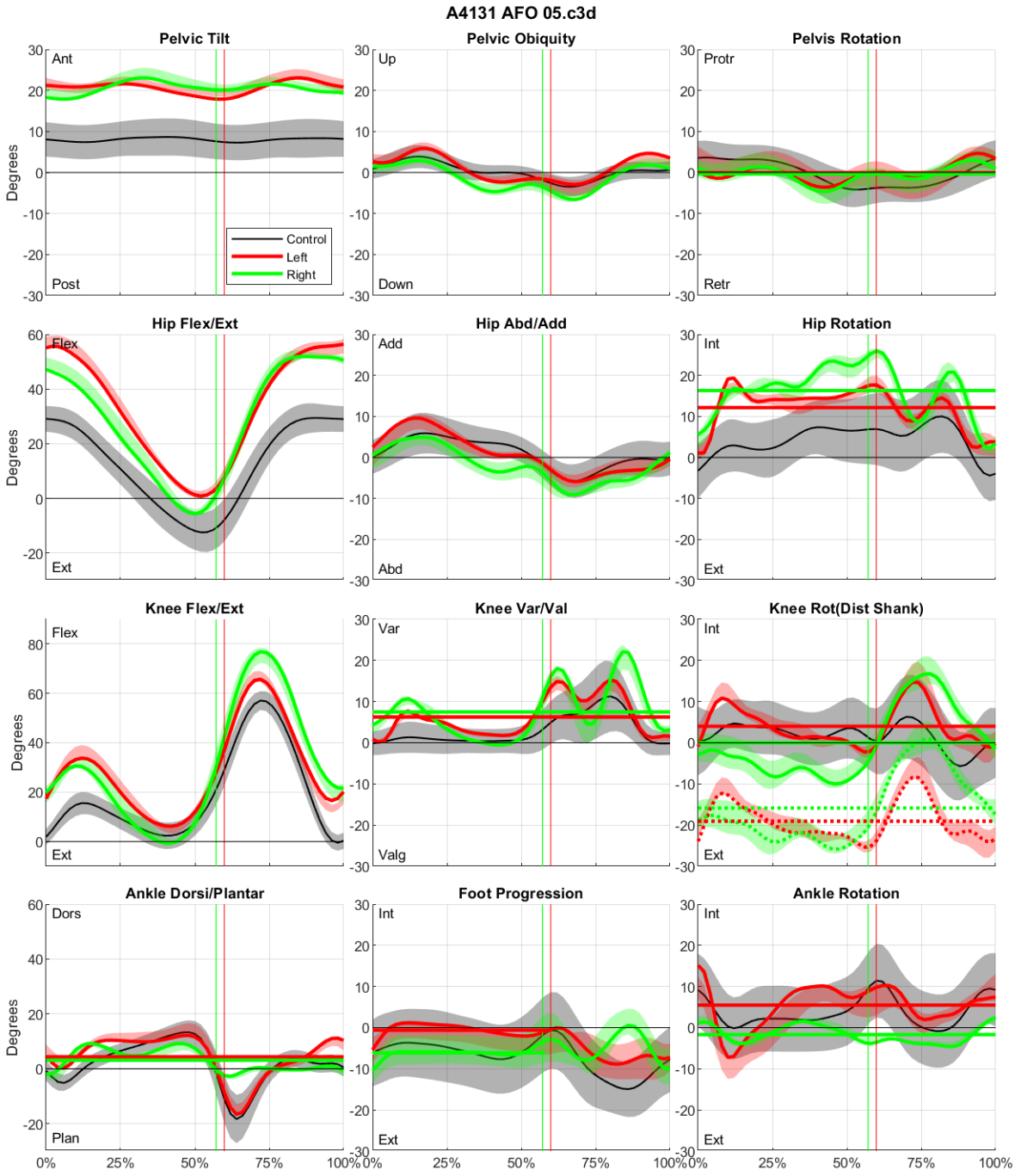
Example of new temporal-spatial data structure. All temporal spatial measures in WAAAG tables are computed as the average of the temporal spatial measures from every gait cycle from each trial imported into WAAAG.

name	units	mean	std	measures	Left_mean	Left_std	Left_measures	Right_mean	Right_std	Right_measures
'Cadence'	'steps/min'	137.4974	2.2285	[137.1429,13...	137.8022	0.9324	[137.1429,138.4615]	137.1926	3.6956	[134.5794,139.8058]
'Walk Speed'	'meters/s'	1.5563	0.0088	[1.5561,1.548...	1.5623	0.0088	[1.5561,1.5686]	1.5502	0.0027	[1.5483,1.5522]
'Stride Leng...	'meters'	1.3584	0.0199	[1.3616,1.380...	1.3605	0.0015	[1.3616,1.3594]	1.3564	0.0341	[1.3805,1.3323]
'Step Length'	'meters'	0.6733	0.0251	[0.7078,0.653...	0.6973	0.0149	[0.7078,0.6867]	0.6574	0.0139	[0.6538,0.6727,0.64...
'Step Width'	'meters'	0.1266	0.0554	[0.1068,0.192...	0.1408	0.0480	[0.1068,0.1748]	0.1172	0.0682	[0.1924,0.0594,0.09...
'Stride Time'	'sec'	0.8729	0.0142	[0.8750,0.891...	0.8708	0.0059	[0.8750,0.8667]	0.8750	0.0236	[0.8917,0.8583]
'Stance'	'%GC'	57.0523	1.8959	[57.1429,55.1...	58.3791	1.7483	[57.1429,59.6154]	55.7254	0.8277	[55.1402,56.3107]
'Init Double...	'%GC'	7.6387	0.1238	[7.6190,7.476...	7.6557	0.0518	[7.6190,7.6923]	7.6218	0.2053	[7.4766,7.7670]
'Single Lim...	'%GC'	42.2442	2.3290	[42.8571,41.1...	44.0247	1.6512	[42.8571,45.1923]	40.4637	0.9303	[41.1215,39.8058]
'Final Doubl...	'%GC'	49.8829	2.3345	[50.4762,48.5...	51.6804	1.7030	[50.4762,52.8846]	48.0855	0.7250	[48.5981,47.5728]
'Left Data'	*1x2 struct*	[]	[]	[]	[]	[]	[]	[]	[]	[]
'Right Data'	*1x3 struct*	[]	[]	[]	[]	[]	[]	[]	[]	[]

Plotting Kinematics

The new processing also allows for automated export of kinematic plots. These can be customized to plot the representative cycle or ensemble average curve. Also one can add curves from all gait cycles from all trials (below) or show a band of the standard deviation around the average (next page). Average rotations can also be plotted.

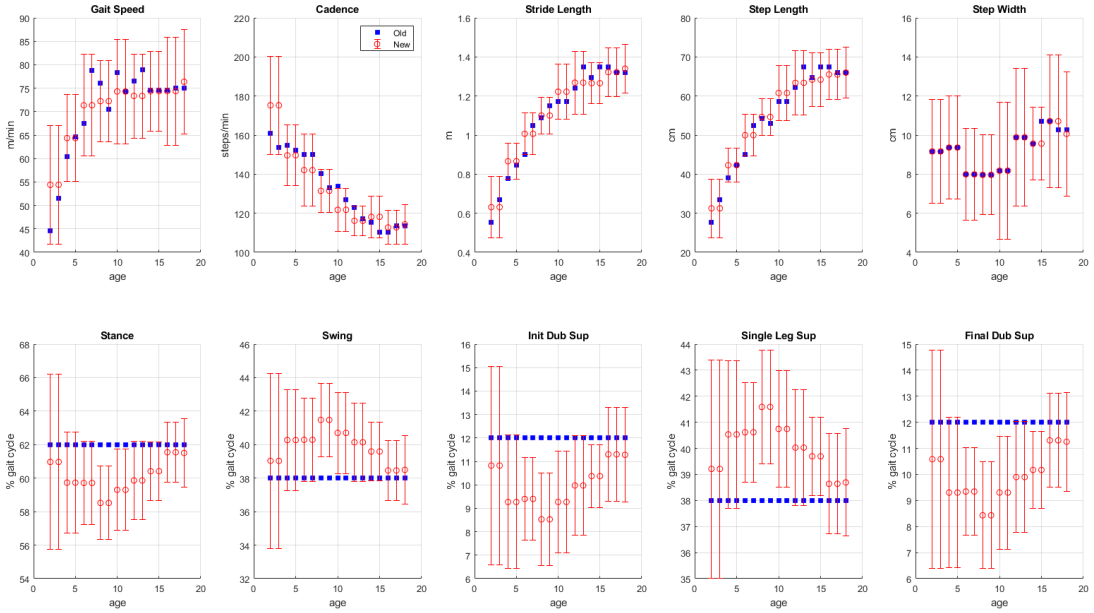




Example kinematic graphs with the rep cycle in the solid line, average rotations as the horizontal lines, and a band of the mean with one standard deviation above and below.

New Temporal-Spatial Norms

Standard deviations for all temporal-spatial parameters were needed for inclusion into the the bands within the temporal spatial parameters plots. These metrics were calculated from CGMAs database of typical walkers and used in place of the old GAMS measures, whose origin is uncertain. Below is a series of plots comparing the old (blue) and new (red) temporal spatial measures for each age group. The general trends are the same, however the addition of temporal-spatial measures provides valuable info.



The benefit of the new temporal-spatial norms is that the standard deviations can be used to set acceptable ranges for each measure, rather than relying on the percentage-based values in WAAAG V1.1. The 'Ok' and 'Poor' ranges were respectively set at 90 and 75% of the target. Now they are set at 1 and 3 standard deviations of the normal group from the norm average.