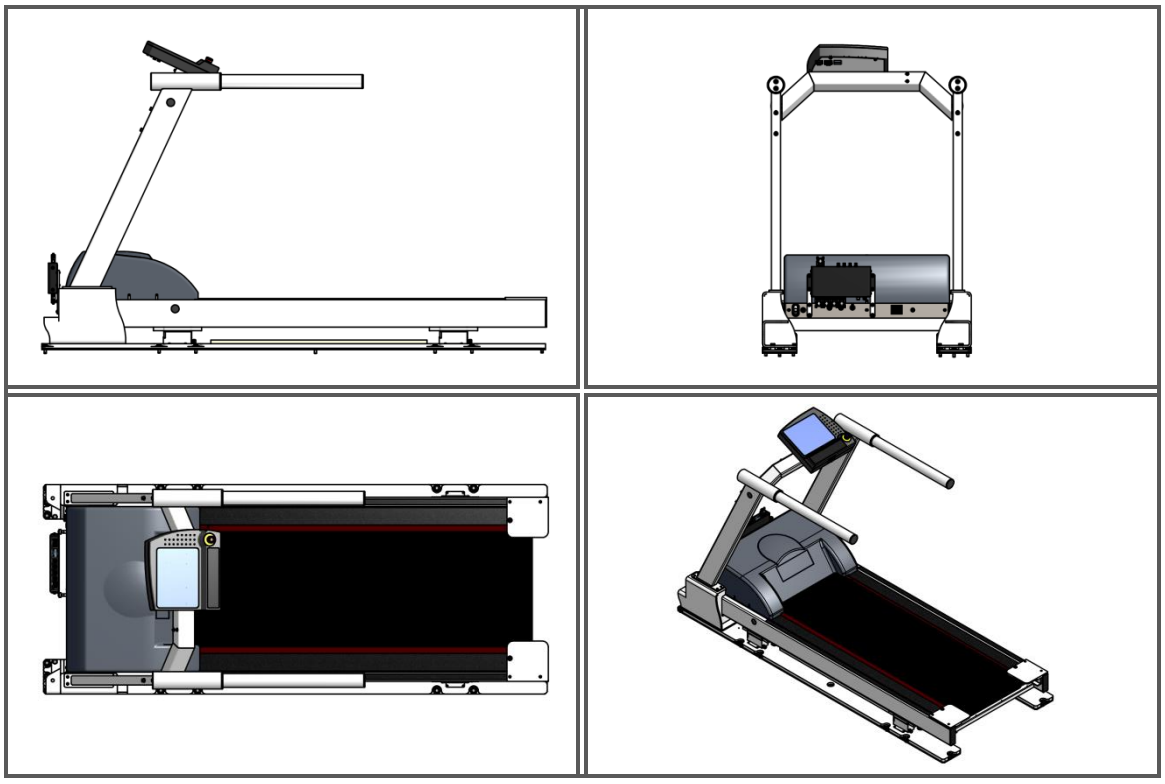
gaitway-3D data streaming Interface Control Document



gaitway-3D treadmill manufacturer:
h/p/cosmos: sports & medical gmbh
Am Sportplatz 8
DE 83365 Nussdorf-Traunstein
Germany
phone +49 86 69 86 42 0
fax +49 86 69 86 42 49
service@hpcosmos.com
www.hpcosmos.com

gaitway-3D Instrumentation manufacturer:
Arsalis SRL
Chemin du Moulin Delay, 6
B-1473 Glabais
Belgium
phone +32 10 474425
fax +32 10 473106
arsalis@arsalis.com
www.arsalis.com

LIST OF ABBREVIATIONS

Abbreviation	Definition
ACK	Acknowledge
AD	Applicable Document
DHCP	Dynamic Host Configuration Protocol
GRF	Ground Reaction Force
ICD	Interface Control Document
I/O	Input/Output
IP	Internet Protocol
LAN	Local Area Network
NAK	Negative acknowledge
PC	Personal Computer
RD	Reference Document
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol over Internet Protocol
USB	Universal Serial Bus
WAN	Wide Area Network

TABLE OF CONTENTS

1. Scope 1
2. gaitway-3D hardware overview 1
2.1. gaitway-3D force signals and reference frame 2
2.2. gaitway-3D force amplifier top panel 3
2.2.1. Status LED 3
2.2.2. Ethernet activity LED 3
2.2.3. Ethernet interface connector 4
2.2.4. Digital inputs and outputs 4
2.2.5. Analog force output 5
3. gaitway-3D software overview 7
4. gaitway-3D data streaming interface description 8
4.1. gaitway-3D data streaming interface architecture 8
4.2. gaitway-3D data streaming interface operation 9
4.3. gaitway-3D data streaming interface settings 10
4.4. Operation scenario with the gaitway-3D data streaming interface 11
4.4.1. Starting the gaitway-3D data streaming mode 11
4.4.2. Connecting to the gaitway-3D data stream 11
4.4.3. Starting the gaitway-3D data streaming 12
4.4.4. Stopping the gaitway-3D data streaming 12
4.4.5. Disconnecting from the gaitway-3D data stream 12
5. Conventions 13
5.1. Data numbering convention 13
5.2. Data type convention 13
5.3. Text format convention 13
6. gaitway-3D data streaming interface commands 14
6.1. General command message format 14
6.2. General response message format 15
6.3. gaitway-3D data streaming commands 16
6.3.1. Get data streaming settings command 16
6.3.2. Start data streaming command 19
6.3.3. Reset baseline output command 27
6.3.4. Stop data streaming command 28
7. Documents 29
7.1. Applicable documents 29
7.2. Reference documents 29

LIST OF TABLES

Table 1. gaitway-3D force signals. 2
Table 2. Status LED state description. 3
Table 3. Ethernet LED state description. 4
Table 4. gaitway-3D digital I/O special functions. 5
Table 5. Analog force out connector pin-out (version C, D and E). 6
Table 6. Data types 13
Table 7. Command message structure. 14
Table 8. Acknowledgment packet structure. 15
Table 9. Data streaming settings packet definition. 17
Table 10. Typical number of samples per type I packet. 23
Table 11. gaitway-3D data stream packet type I content. 23
Table 12. gaitway-3D data packet type I header content. 23
Table 13. gaitway-3D data packet type I sample content. 24
Table 14. gaitway-3D data stream packet type II content. 25
Table 15. gaitway-3D data packet type II header content. 25
Table 16. gaitway-3D data packet type II sample content. 26

LIST OF FIGURES

Figure 1. gaitway-3D 150/50 overview. 1
Figure 2: gaitway-3D 150/50 reference frame. 2
Figure 3: gaitway-3D force amplifier front panel. 3
Figure 4. Analog force out connector front panel pin-out view. 6
Figure 5. gaitway-3D software welcome screen. 7
Figure 6: gaitway-3D data streaming signal architecture. 8
Figure 7: gaitway-3D data streaming screen. 9
Figure 8: gaitway-3D data streaming settings screen. 11

1. Scope

This document describes the signal and communication interface with the data streaming mode of the gaitway-3D software. When used in data streaming mode, the gaitway 3D can be used as a virtual instrument. The signal interface consists of the force amplifier top panel connectors providing digital input/outputs as well as user visual indicators. The communication interface consists in commanding and monitoring messages that are sent to and from the gaitway-3D software.

2. gaitway-3D hardware overview

The gaitway-3D 150/50, illustrated in Figure 1, is an instrumented treadmill based on the h/p/cosmos model stratos® med, equipped with three dimensional ground reaction force measurement sensors. The gaitway-3D 150/50 instrumentation components include four transducers supporting the treadmill and the force amplifier fixed in front of the treadmill, as shown in Figure 1.

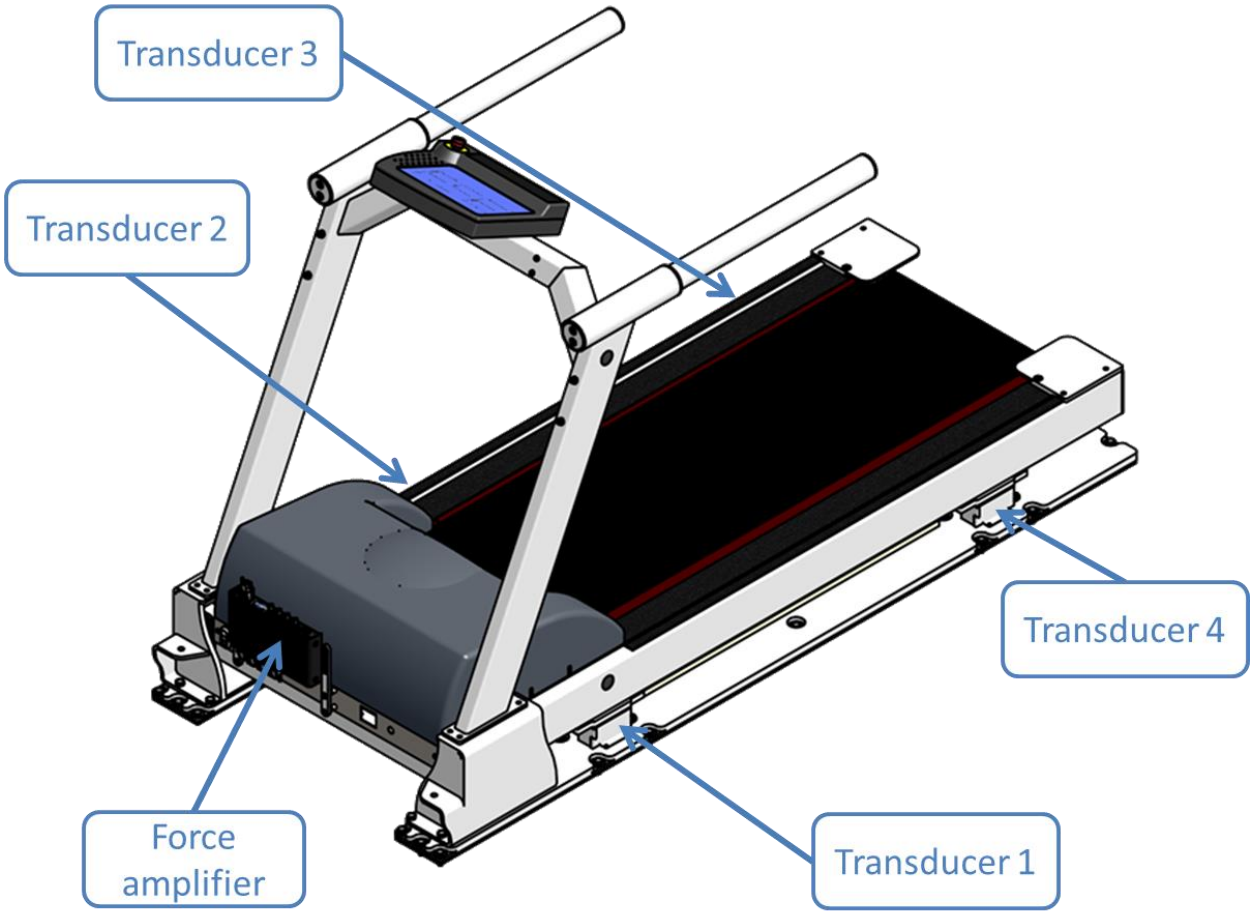


Figure 1. gaitway-3D 150/50 overview.

2.1. gaitway-3D force signals and reference frame

The gaitway-3D instrumentation reports the ground reaction forces (GRF) as measured by a set of four transducers as indicated in Figure 2: load cell 1 is placed at the front left corner, load cell 2 is placed at the front right corner, load cell 3 is placed at the rear right corner and load cell 4 is placed at the rear left corner.

The ground reaction forces are reported as a set of 8 signals: 4 in the vertical direction, 2 in the fore-afterwards direction and 2 in the medio-lateral direction. The resultant force applied by the patient on the treadmill belt is expressed in the reference frame illustrated in Figure 2 as an example for a gaitway 3D 150/50. For this model, the origin is located at the rear right corner of the treadmill roller cover plate. The geometrical center of the rectangle defined by the four transducers (O in Figure 2) is located at a distance of 400 x 1005 mm from the origin. The treadmill frame size in the plane of the locomotion surface has a width of 800 mm and a length of 1515 mm at the side and of 1586 mm at the center of the belt. The reference frame arrows in Figure 2 indicate the orientation of positive forces applied by the patient.

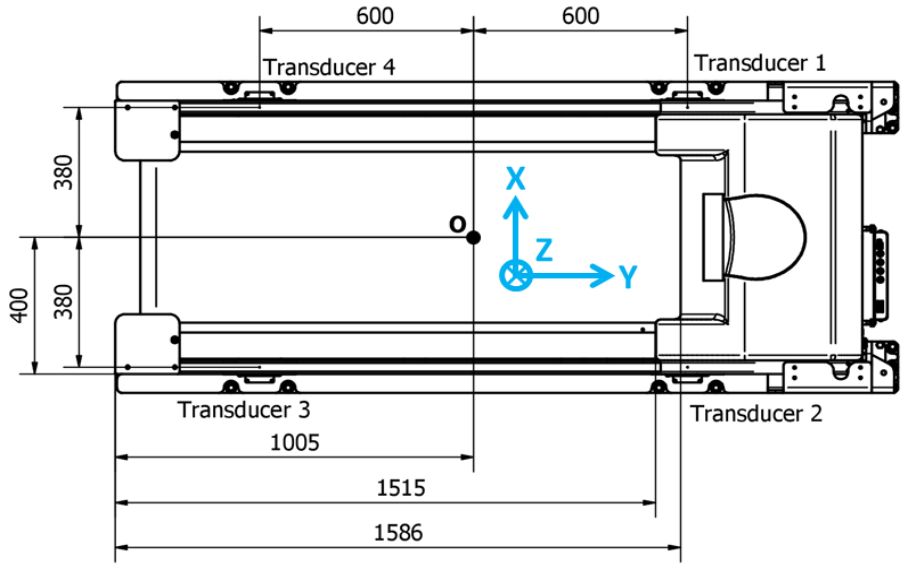


Figure 2: gaitway-3D 150/50 reference frame.

The force signals are listed in Table 1.

Table 1. gaitway-3D force signals.

Channel	Description
Z1	Vertical GRF recorded at transducer 1
Z2	Vertical GRF recorded at transducer 2
Z3	Vertical GRF recorded at transducer 3
Z4	Vertical GRF recorded at transducer 4
Y14	Fore-afterwards GRF recorded at transducers 1 and 4
Y23	Fore-afterwards GRF recorded at transducers 2 and 3
X12	Lateral GRF recorded at transducers 1 and 2
X34	Lateral GRF recorded at transducers 3 and 4

2.2. gaitway-3D force amplifier top panel

The gaitway-3D amplifier top panel, illustrated in Figure 3, provides visual indicators and connectors for signal interface. The functions available at the front panel are described below.

Figure 3: gaitway-3D force amplifier front panel.

2.2.1. Status LED

The status LED (red at right side of Figure 3) shows the status of the gaitway-3D instrumentation according to the different states described in Table 2.

Table 2. Status LED state description.

Status LED state	Description
LED is OFF	The gaitway-3D 150/50 instrumentation is not powered.
LED blinks at 1Hz with a duty cycle of 1/8	The gaitway-3D 150/50 instrumentation is operational and no error is logged.
LED blinks at 1 Hz and makes a double flash	The gaitway-3D 150/50 instrumentation is acquiring data.
LED is always on	The gaitway-3D 150/50 instrumentation is waiting for a trigger.
LED blinks fast	The gaitway-3D 150/50 instrumentation is operational and at least one error is logged.

2.2.2. Ethernet activity LED

The Ethernet activity LED (green at right side of Figure 3) shows the status of the gaitway-3D instrumentation Ethernet connection according to the different states described in Table 3.

Table 3. Ethernet LED state description.

Status LED state	Description
LED is OFF	No Ethernet Link.
LED is ON	Ethernet Link is established.
LED is flashing	Activity on the Ethernet port.

2.2.3. Ethernet interface connector

The Ethernet interface connector, RJ-45, provides a software interface to the gaitway 3D software designed to be used over a Local Area Network (LAN) according to IEEE 802.3. The interface is implemented in a point-to-point client/server configuration. The gaitway-3D force amplifier is the server providing a TCP/IP socket and accepts one single socket connection at a time. The gaitway-3D software is the client responsible to establish connection with the force amplifier.

At start-up, the gaitway-3D force amplifier gets an IP address from a DHCP server. The DHCP server must be configured such that it provides an IP address to the gaitway-3D force amplifier in the same subnet as the PC running the gaitway-3D software. A typical configuration would be to set the address of the gaitway-3D force amplifier in the range of 192.168.0.101 to 192.168.0.255, with a subnet mask 255.255.255.0 and the gateway at an address of 192.168.0.1. If no DHCP server is present, the gaitway-3D force amplifier defaults to a static IP address of 192.168.0.101 with subnet mask 255.255.255.0 and gateway 192.168.0.1. The gaitway-3D software runs on a PC using the Windows 7/8/10 operating system with an IP address in the same subnet (a default static IP address of 192.168.0.100 is convenient in most cases).

2.2.4. Digital inputs and outputs

The gaitway 3D-force amplifier has 4 digital inputs/outputs. All digital inputs/outputs signals are 5V digital signals compatible TTL and CMOS input and output levels. All digital I/O signals are electrically isolated and share a common isolated ground. All digital inputs have a weak pull-up resistor that set the default input to a high state.

All digital I/O signals of the force amplifier are recorded synchronously with the analog signals from the force transducers: a high voltage, i.e. 5V, is coded as 1 and a low voltage, i.e. 0V, is coded as 0. The 'Trig In' and 'Aux In' can be used a static digital inputs to mark any external event. In addition, the digital inputs/outputs can be assigned a special function via the gaitway-3D software, according to Table 4.

- The "Zero in" function should be activated when the patient is not on gaitway-3D 150/50 treadmill and when no object is touching the treadmill.
- The Analog Force outputs are not valid while the analog signal baselines are being reset.

Table 4. gaitway-3D digital I/O special functions.

Channel	Special function	Default
Sync out	Outputs a signal in synchrony with the sampling of the force transducers signals. Output polarity and frequency are under control of the gaitway-3D software.	- High during acquisition - Low when acquisition is stopped
Trig in	Trigger input function can be set under control of the gaitway-3D software either to start the acquisition or to stop the acquisition. The input polarity is also under control of the gaitway-3D software.	- Static input - If trigger enabled: start trigger on falling edge
Aux in	Auxiliary input function can be set under control of the gaitway-3D software either to start the acquisition or to stop the acquisition. The input polarity is also under control of the gaitway-3D software.	- Static input - If trigger enabled: stop trigger on falling edge
Zero in	If not acquiring data, pulling the input low resets the baseline output voltage to the default value for each direction (Z = 0.122 V, Y = X = 5V). The baseline reset operation lasts approximately 350 milliseconds, and during this period the analog outputs are not valid.	- Normally high

2.2.5. Analog force output

The Analog Force output connector is used to provide an analog copy of the eight force signals measured by the force transducers (version C, D and E) and of the treadmill speed (version E only). The voltage output for each signal is ground referenced, within a range of 0 to 10 V and is rated 10 mA for version C & D1 and 1 mA for version D2 and E and has an impedance of 100 Ohm. The internal analog ground of the amplifier is separated from the external ground (GNDIO) with a 100 Ohm resistor. The connector pin-out is presented in Table 5 and in Figure 4.

A Bessel 8-pole low pass filter with cut-off frequency of 125 Hz is built into the gaitway-3D amplifier for all analog signals. Therefore, a group delay of 4 milliseconds is imposed to all analog signals relative to the four digital I/O signals. When using the analog output interface, the analog output signals are thus delayed by a frequency-independent delay of 4 milliseconds relative to the digital I/O signals.

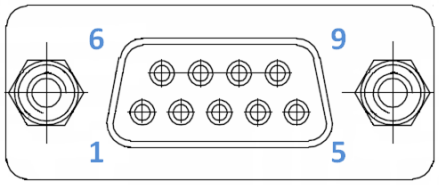
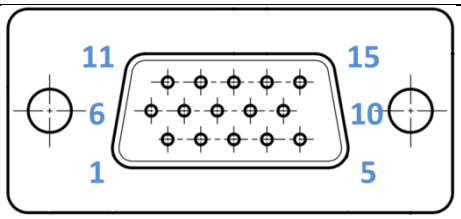
Version C & D	Version E
	

Figure 4. Analog force out connector front panel pin-out view.

Table 5. Analog force out connector pin-out (version C, D and E).

Pin number		Signal	Type	Description
v. C&D	v. E			
1	1	LPF_EX34_OUT	Filtered analog signal	Sum of Rear Left and Rear Right force sensors in the X direction
2	2	LPF_EX12_OUT	Filtered analog signal	Sum of Front Left and Front Right force sensors in the X direction
3	3	LPF_EY23_OUT	Filtered analog signal	Sum of Front Right and Rear Right force sensors in the Y direction
4	4	LPF_EY14_OUT	Filtered analog signal	Sum of Front Left and Rear Left force sensors in the Y direction
5	5	LPF_EZ4_OUT	Filtered analog signal	Force in Z direction on Rear Left force sensor
6	6	LPF_EZ3_OUT	Filtered analog signal	Force in Z direction on Rear Right force sensor
7	7	LPF_EZ2_OUT	Filtered analog signal	Force in Z direction on Front Right force sensor
8	8	LPF_EZ1_OUT	Filtered analog signal	Force in Z direction on Front Left force sensor
NA	10	SPEED_OUT	Filtered analog signal	Analog treadmill speed
9	15	GNDIO	External ground	External ground for signal reference
Shield	Shield	Chassis	PE	Connected to chassis of amplifier

3. gaitway-3D software overview

A detailed description of the gaitway-3D software functions is provided in RD 6. The gaitway-3D software offers 3 modes of operation;

- VIEW DATA: to view and analyze recorded data;
- MEASURE: to record new data;
- STREAM DATA: to stream data towards a third party application.

The latter mode, STREAM DATA, needs to be selected to enable the data streaming interface.

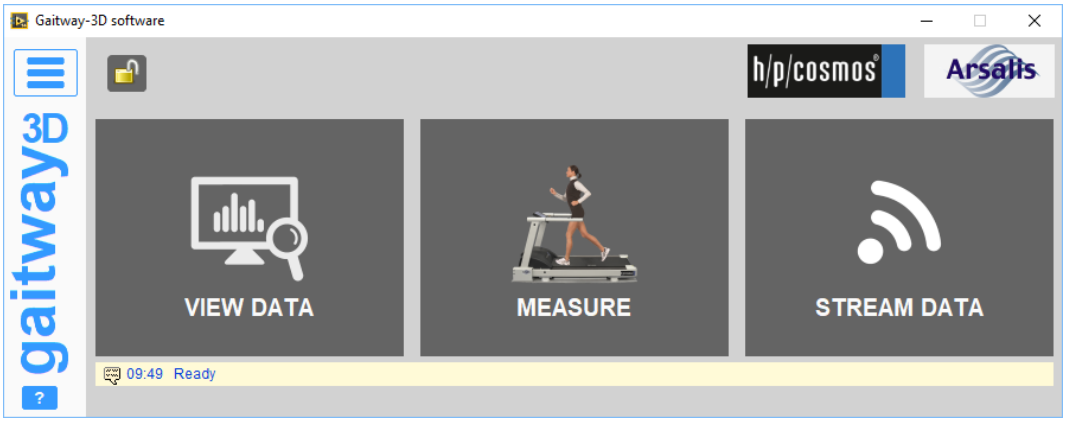


Figure 5. gaitway-3D software welcome screen.

4. gaitway-3D data streaming interface description

4.1. gaitway-3D data streaming interface architecture

When using the data streaming interface, the gaitway-3D system effectively becomes a virtual instruments. The gaitway-3D software allows the operator to control the hardware settings for the treadmill (e.g. setting treadmill speed) and force amplifier (e.g. acquiring ground reaction forces), but instead of displaying and storing the recorded signals, the gaitway-3D software sends the data to a third party application.

The gaitway-3D data streaming interface is implemented over an Ethernet connection between the gaitway-3D software and the third party application, according to the architecture illustrated in Figure 6. The gaitway-3D force amplifier, the computer hosting the gaitway-3D software and the computer hosting the third party application are connected via a router over a Local Area Network (see blue cables in Figure 6). An example of DHCP settings and IP addresses automatically attributed to each device on the LAN is also illustrated (see light blue boxes in Figure 6). In addition, the computer hosting the gaitway-3D software also has a serial connection to the gaitway-3D treadmill controller (see purple cable in Figure 6). An optional digital interface cable can be used for the third party application to send digital signals to the gaitway-3D force amplifier either to trigger the data streaming or to mark synchronization events (see green cable in Figure 6).

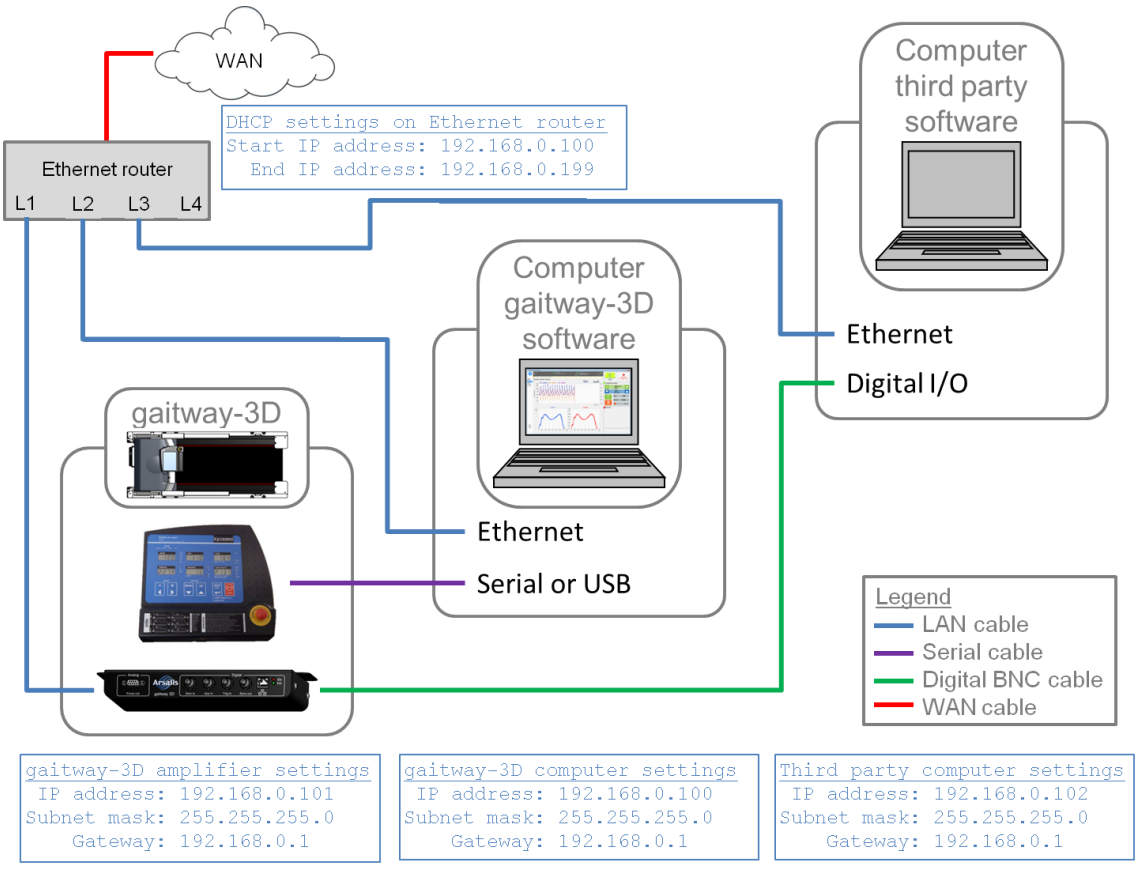


Figure 6: gaitway-3D data streaming signal architecture.

Note that the LAN & WAN configurations shown in Figure 6 only illustrate one possible setup allowing the gaitway-3D data streaming. Other network configurations, such as running the gaitway-3D software and third party application on the same computer or running the third party application in the WAN can also be used provided that a secure access is granted to each individual component over the network.

4.2. gaitway-3D data streaming interface operation

Upon startup, the gaitway-3D data streaming interface resets the baseline output values for the gaitway-3D force amplifier. Then the data streaming interface is enabled.

The gaitway-3D data streaming interface screen is illustrated in Figure 7. It displays the IP address of the computer hosting the gaitway-3D software so that the third party application can establish a TCP/IP socket with it. In the data streaming mode, the gaitway-3D first software establishes connection to the gaitway-3D hardware (i.e. the treadmill and force amplifier), in order to apply the settings and control the hardware from the user interface. The gaitway-3D software then waits for a socket to be established by the third party application over the port 49500; only one socket can be established at once. Once the socket is established, the gaitway-3D software waits for a command from the third party application. The gaitway-3D software also displays the status of the connection from the third party software and streaming of data packets.

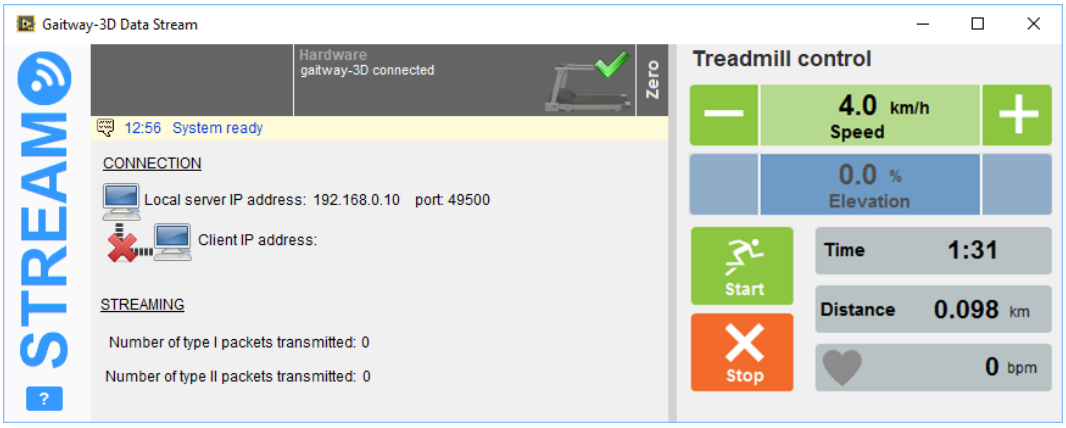


Figure 7: gaitway-3D data streaming screen.

The third party application is responsible to establish connection with the gaitway-3D software, to send commands over the socket once established and to read the replies sent by the gaitway-3D software. Once the data acquisition is started, the gaitway-3D software will stream data packets to the third party application, which will be responsible for data processing, display and recording. The gaitway-3D software does not record or store any data streamed out to the third party application.

4.3. gaitway-3D data streaming interface settings

The gaitway-3D data streaming interface settings are illustrated in Figure 8. The settings are split in two categories: the settings for the force amplifier and the settings for the treadmill. Note that those settings apply specifically to the data streaming mode of the gaitway-3D software.

For the force amplifier, the settings include:

- The cutoff frequency for the low-pass filter (Bessel, 8^{th} order) applied to the ground reaction forces, center of pressure, torques and treadmill speed signals.
- The Trigger mode settings for starting and stopping the data streaming.
- The Sync Out pattern settings during data streaming.
- The coordinates of the right rear corner of the gaitway 3D treadmill in the global referential where the center pressure will be expressed. For instance, in order to express the center of pressure relative to the geometrical center of the force transducers, X_0 should be set to -400 and Y_0 should be set to -1005 on a gaitway-3D 150/50 system.

For the treadmill, the settings include:

- The acceleration/deceleration level of the treadmill belt. Note that the levels can be restricted by the treadmill options. Refer to the h/p/cosmos documentation concerning the treadmill user options.
- The delay before a speed setting becomes effective when a new speed is entered in the gaitway-3D software treadmill control interface. If the value is different than zero, a countdown is displayed while waiting for new speed to be set.
- The self-speed control mode. If this mode is enabled, the treadmill speed is automatically changed depending on the position of the patient on the treadmill. If the average center of pressure is the front part of the treadmill, the belt accelerates; in the middle zone, the speed remains unchanged and in the rear zone, the treadmill decelerates. Note that this mode is active only when data streaming is in progress and the patient walks or runs at a speed higher than 1 km/h. An indicator below the speed display informs the operator when this mode is active.
- The treadmill displays and controls units. The operator can select either Metric or Imperial units.

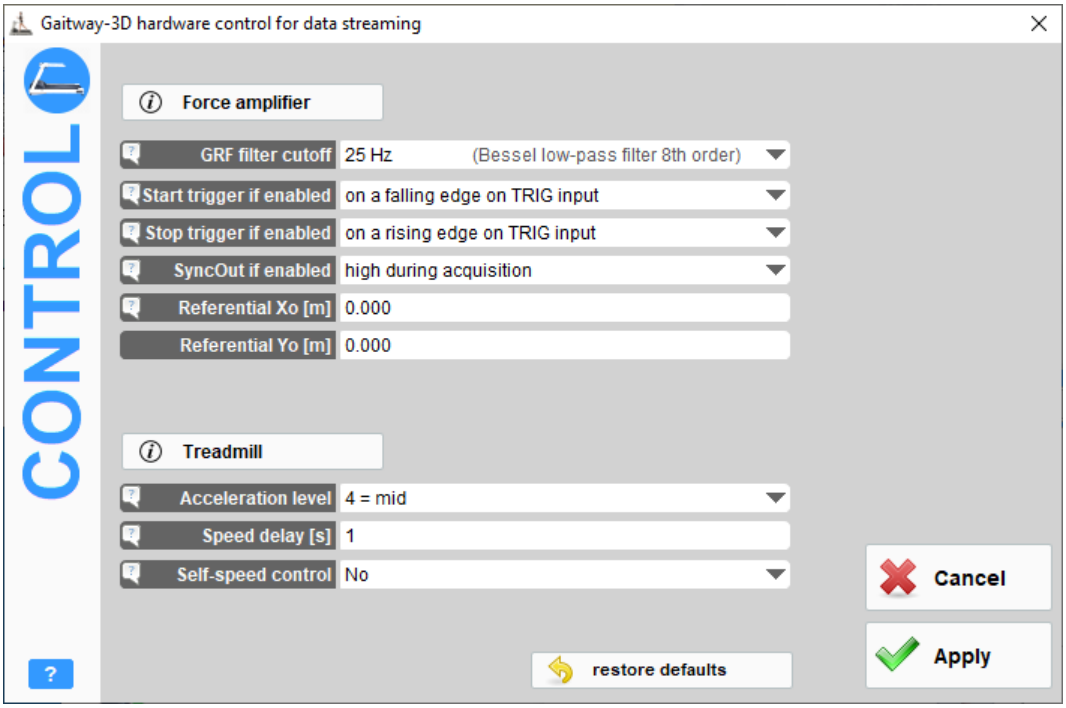


Figure 8: gaitway-3D data streaming settings screen.

4.4. Operation scenario with the gaitway-3D data streaming interface

4.4.1. Starting the gaitway-3D data streaming mode

The following steps allow starting the data streaming interface:

1) Start the gaitway-3D software.
2) Select STREAM DATA mode. The software automatically connects to the hardware, takes control of the treadmill and force amplifier hardware settings and resets the baseline output of the gaitway-3D force amplifier.
3) The software displays the IP address of the host computer for the third party application to establish a TCP/IP connection with the host computer.

4.4.2. Connecting to the gaitway-3D data stream

The following steps allow connecting to the gaitway-3D data streaming interface:

1) The IP address of the computer hosting the gaitway-3D software and the connection status are displayed in the data streaming user interface screen. The third party application opens a TCP/IP socket over port 49500 with the computer hosting the gaitway-3D software.
2) Once the connection is established the gaitway-3D software displays the status of the data stream. Only one TCP/IP socket can be established at once with the data gaitway-3D data streaming interface. In order to establish a new socket, the previous one needs to be disconnected.

4.4.3. Starting the gaitway-3D data streaming

The following steps allow starting the gaitway-3D data streaming:

1) The third party application sends the start data streaming command (see command `startDS` in section 6.3.2) and the gaitway-3D software starts sending data packets. The first type of packets is sent at frequency of 25 Hz and contains the total (both feet) GRF and treadmill signals; the second type of packets is sent at the step frequency (normally less than 3 Hz) and contains the individual step forces (signals individualized for left and right steps). The data streaming can either be started for an indefinite period or for a fixed number of samples.
2) The third party application reads each packet as they are received in its TCP/IP socket.

4.4.4. Stopping the gaitway-3D data streaming

The following steps allow stopping the gaitway-3D data streaming:

1) If the third party application sent the `startDS` command to send a finite number of samples, the data streaming ends automatically once the requested number of samples is sent. Then, the data streaming interface waits for a new command.
2) If the third party application sent the `startDS` command to send an indefinite number of samples, the data streaming can be stopped by sending the stop data streaming command (see `stopDS` in section 6.3.4). Then, the data streaming interface waits for a new command.

4.4.5. Disconnecting from the gaitway-3D data stream

The following steps allow disconnecting from the gaitway-3D data streaming interface:

1) The third party application closes the TCP/IP socket previously opened.
2) Once the socket is closed, the gaitway-3D software is ready for a new socket to be opened by a third party application

5. Conventions

5.1. Data numbering convention

All commands use ASCII coded numeric parameters interpreted as unsigned integer, unless explicitly defined otherwise.

All values returned by the commands are packets with a specified size and type and with a format specified for each response.

The binary representation of numeric values in this document follows the little endian convention unless explicitly defined otherwise. For multiple-byte fields, the most significant byte is represented to the left and the least significant byte is represented to the right. Within each byte, the most significant bit (i.e. bit number 7) is represented to the left and the least significant bit (i.e. bit number 0) is represented to the right.

Hexadecimal representations of numeric values in this document are preceded with the 0x prefix.

5.2. Data type convention

The data types used in the gaitway-3D software interface are listed in Table 6.

Table 6. Data types.

Type	Description
U16	Unsigned 16-bit integer.
U32	Unsigned 32-bit integer.
SF32	Single precision floating point 32-bit value.
char[n]	String of ASCII characters, null terminated containing up to n-1 characters and the null terminating character.

5.3. Text format convention

All text written in the standard Arial font in this document describes the data streaming interface to the gaitway-3D software. Text written in the `Courrier New` font indicates byte codes expressed in binary or hexadecimal format or specific commands of the interface. ASCII characters are written in `Courrier New` font and between <>, such as `<CR>` for carriage return.

6. gaitway-3D data streaming interface commands

6.1. General command message format

All command messages are issued by the third party application to the gaitway-3D software. The gaitway-3D software does not spontaneously initiate the communication. The gaitway-3D software executes one command at the time. If the gaitway-3D software receives a new command while the previous command is being executed, the new command will be stacked in the IP buffer and will be treated when the execution of the previous command is complete. The only exception to the later rule concerns the `stopDS` command that will stop the data streaming if it is currently active.

All command messages from the third party application to the gaitway-3D software are composed of a command ID followed by up to 6 parameters and a '`CRLF`' message terminator. The command messages consist in ASCII character fields and all subsequent fields are separated by an ASCII '`space`' character. The parameters for any command are unsigned integers coded in ASCII. The command message length varies with the command ID and with the number and range of acceptable values for each parameter according to Table 7. The reply to each message is described for each command in the following sections.

Table 7. Command message structure.

Field number	Field required for any command	Field name	Size (bytes)	Description
1	Yes	Command ID	6 to 13	ASCII characters, case sensitive.
2	No	Separator	1	1 <space> character: ASCII character 0x20.
3	No	Parameter 1	1 to 5	Unsigned integer value coded in ASCII format.
4	No	Separator	1	1 <space> character: ASCII character 0x20.
5	No	Parameter 2	1 to 5	Unsigned integer value coded in ASCII format.
6	No	Separator	1	1 <space> character: ASCII character 0x20.
7	No	Parameter 3	1 to 5	Unsigned integer value coded in ASCII format.
8	No	Separator	1	1 <space> character: ASCII character 0x20.
9	No	Parameter 4	1 to 5	Unsigned integer value coded in ASCII format.
10	No	Separator	1	1<space> character: ASCII character 0x20.
11	No	Parameter 5	1 to 5	Unsigned integer value coded in ASCII format.
12	No	Separator	1	1 <space> character: ASCII character 0x20.
13	No	Parameter 6	1 to 5	Unsigned integer value coded in ASCII format.
14	Yes	Message end	2	<CR><LF> carriage return & line feed terminator: ASCII character 0x0D followed by 0x0A.

6.2. General response message format

All command messages from the third party application are acknowledged by the gaitway-3D software via the transmission to the sender of an acknowledgment packet including the command received. To be accepted, a command must include a correct ID, a correct number of parameters, parameter values within range and the correct parameter separator. All commands are acknowledged by a re-transmission of an acknowledgment packet. Then, after the transmission of the acknowledgment packet, command is executed if it has been accepted. Any command that does not meet the correct format is rejected. Rejected commands are not executed and no error is logged. The acknowledgment packet structure is described in Table 8.

Table 8. Acknowledgment packet structure.

Field number	Field name	Field type	Size (bytes)	Description
1	Packet size (bytes)	U16	2	Total size of acknowledgement packet, including the first field, expressed in byte.
2	Packet type	U16	2	0x0006, if command is acknowledged and will be executed; 0x0015, if command is not acknowledged and will not be executed.
3	Command	char[49]	up to 49	Copy of the command received without the <CR><LF> message end.

6.3. gaitway-3D data streaming commands

6.3.1. Get data streaming settings command

The `getDSsettings` command takes no parameter. It reports the command acknowledgement followed by a binary packet containing the data streaming settings according to Table 9.

Command	**Get data streaming settings**	
Command ID	`getDSsettings`	
Parameters	**Value**	**Description**
Parameter 1	None	None
Parameter 2	None	None
Parameter 3	None	None
Parameter 4	None	None
Parameter 5	None	None
Parameter 6	None	None
Response	Acknowledgement Binary packet according to Table 9	
Example transmission		
Third party software transmission `getDSsettings<CR><LF>`		gaitway-3D software transmission `0x000F 0x0006 getDSsettings` Binary packet according to Table 9
Example transmission		
Third party software transmission `readDSsettings<CR><LF>`		gaitway-3D software transmission `0x0012 0x0015 readDSsettings`
Example transmission		
Third party software transmission `getDSsettings 1<CR><LF>`		gaitway-3D software transmission `0x0013 0x0015 getDSsettings 1`

The binary packet transmitted upon acknowledgment of the `getDSsettings` command is composed of 28 fields according to Table 9.

Table 9. Data streaming settings packet definition.

Field number	Field name	Field type	Description	Example value
Data streaming interface settings				
1	Packet size (bytes)	U16	Total size of packet, including the first field, expressed in byte.	163
2	Packet type	U16	Set to 0 indicating data streaming settings packet.	0
3	DS settings version	U16	Version number for data streaming settings.	1
4	DS client access authorization	U16	Default: `0x0000` Bit 0 is set if access is authorized for gw3dNexusPlugin.vdd	0
Dimensional settings				
5	Force plate width (m)	SF32	Medio-lateral dimension of the locomotion surface along the X axis, expressed in meter.	0.8
6	Force plate length (m)	SF32	Fore-afterwards dimension of the locomotion surface along the Y axis, expressed in meter.	1.5858
7	Width between force transducers (m)	SF32	Medio-lateral distance between force transducers along the X axis, expressed in meter.	0.76
8	Length between force transducers (m)	SF32	Fore-afterwards distance between force transducers along the Y axis, expressed in meter.	1.2
9	X coordinate center of transducers (m)	SF32	Medio-lateral coordinate of the center of the four force transducers along the X axis, expressed in meter.	0.4
10	Y coordinate center of transducers (m)	SF32	Fore-afterwards coordinate of the center of the four force transducers along the Y axis, expressed in meter.	1.005
Treadmill settings				
11	Treadmill acceleration level	U16	Level of acceleration of the treadmill	4
12	Treadmill speed delay (s)	U16	Delay between speed setting and speed change, expressed in second	4
13	Treadmill self-speed control	U16	Self-speed control mode status. Possible values are: `0` if self-speed is disabled `1` if self-speed is enabled	0
Force amplifier settings				
14	GRF Z range (N)	U16	Range of vertical force measurement for each transducer along the Z axis, expressed in Newton	2634
15	GRF Y range (N)	U16	Range of fore-afterwards force measurement for each transducer along the Y axis, expressed in Newton	750

Field number	Field name	Field type	Description	Example value
16	GRF X range (N)	U16	Range of medio-lateral force measurement for each transducer along the X axis, expressed in Newton	750
17	GRF filter Cutoff (Hz)	U16	Cutoff frequency of low pass filter applied to the raw signals, expressed in Hertz	40
18	GRF COP threshold (N)	U16	Threshold vertical ground reaction force above which the position of the center of pressure is computed, expressed in Newton.	150
19	GRF referential X_0 (m)	SF32	Medio-lateral coordinate of the referential origin (i.e. the rear right corner of treadmill frame) along the X axis, expressed in meter.	0.000
20	GRF referential Y_0 (m)	SF32	Fore-afterwards coordinate of the referential origin (i.e. the rear right corner of treadmill frame) along the Y axis, expressed in meter.	0.000
21	GRFfiltering	char[64]	Type of low pass filter applied to all signals, expressed as a null terminated string containing up to 63 characters. Possible values are: `1:Bessel low-pass filter 8th order`	`1:Bessel low-pas filter 8th order`

22	GRFrecordStart	char[64]	Start condition for data streaming after acknowledgment of the `startDS` command, expressed as a null terminated string containing up to 63 characters. Note that the start condition is enabled/disabled in the `startDS` command.
			
			Possible values are:
			`1:on a falling edge on TRIG input`
			`2:on a rising edge on TRIG input`
			`3:on a falling edge on AUX input`
			`4:on a rising edge on AUX input`
				`1:on a falling edge on TRIG input`

23	GRFrecordEnd	char[64]	Stop condition for data streaming after acknowledgment of the `startDS` command, expressed as a null terminated string containing up to 63 characters. Note that the stop condition is enabled/disabled in the `startDS` command.
			
			Possible values are:
			`1:on a falling edge on TRIG input`
			`2:on a rising edge on TRIG input`
			`3:on a falling edge on AUX input`
			`4:on a rising edge on AUX input`
				`2:on a rising edge on TRIG input`

Field number	Field name	Field type	Description	Example value
24	GRFSyncOut	char[16]	Sync output signal during data streaming after acknowledgment of the `startDS` command, expressed as a null terminated string containing up to 15 characters. Note that the sync output is enabled/disabled in the `startDS` command. Format is: two dash separated numbers. The first number is the number of samples between successive sync pulses during acquisition (0 = sync out is set to its polarity during the whole acquisition, 1= pulse every sample, 2 = pulse every other sample, n = set at polarity for one sample every n samples) The second digit is the polarity of the sync pulse (0= LOW, 1= HIGH).	`2-0`
Product settings				
25	Instrumentation Product	char[16]	Instrumentation product identification, expressed as a null terminated string containing up to 15 characters.	`TM`
26	Instrumentation Model	char[32]	Instrumentation model identification, expressed as a null terminated string containing up to 31 characters.	`GAITWAY-3D 150/50`
27	Instrumentation S/N	char[12]	Instrumentation serial number, expressed as a null terminated string containing up to 11 characters.	`P001-170001`
28	Treadmill S/N	char[32]	Treadmill serial number, expressed as a null terminated string containing up to 31 characters.	`cos30000va02-0006`

6.3.2. Start data streaming command

The `startDS` command reports the command acknowledgement then sets all hardware settings and starts the data acquisition from the hardware together with the data streaming to the third party application. Once started, the data streaming will send force and treadmill signals as binary packets over the TCP/IP socket established by the third party software, until the data streaming is stopped. During the data packets transmission, no command other than `stopDS` will be accepted by the gaitway-3D software.

The `startDS` command takes 6 parameters. The sample frequency specifies the number of samples per second acquired from the force amplifier and internally synchronized with the treadmill signals. The number of samples specifies how long the data will be streamed after the acknowledgement of the command; a zero value specifies an indefinite data streaming.

The data streaming can start immediately upon acknowledgment of the `startDS` command or once a start trigger is received. If the start trigger is disabled, the gaitway-

3D software will start the data streaming immediately upon acknowledgment of the command. If the start trigger' is enabled, the gaitway-3D software will wait for the start trigger to be received by the force amplifier, according to the start trigger settings in the gaitway-3D software, before starting the data acquisition and streaming.

The data streaming can be stopped after a given number of samples is transmitted, once a stop trigger is received or when the `stopDS` command is received; whichever of the specified condition comes first. If the stop trigger is disabled, the gaitway-3D software will stop the data streaming when the specified number of samples is transmitted. If the stop trigger is enabled, the gaitway-3D software will stop the acquisition and data streaming when the stop trigger is received by the force amplifier, according to the stop trigger settings in the gaitway-3D software.

The sync output of the force amplifier can be enabled or disabled during the data streaming; when enabled, this output can be used to trigger another device in synchrony with the force data acquisition or to clock each frame of another device, such as a camera, in synchrony with the force signal acquisition. If the 'enable sync output' parameter is set to 0, the force amplifier will leave the sync output to its default value (either high or low) during the data streaming. If the 'enable sync output' parameter is set to 1, the force amplifier will control the sync during the data streaming, according to the sync output settings in the gaitway-3D software.

The data stream consists of 2 types of binary packets:

- type I packets contain the raw signals from the gaitway-3D force amplifier and treadmill and are transmitted at intervals of typically 40 milliseconds;
- type II packets contain the ground reaction forces for each single step and are transmitted at typical intervals of 300 milliseconds or more for slower gaits.

Data packets of Type I (see content definition in Table 11) contain the calibrated and filtered raw data. Data packets of type II (see content definition in Table 14) contain ground reaction force signals, separately for the left and the right foot, during each step. Each step lasts from one foot contact (i.e. right foot contact for a right step) until the next foot contact (i.e. left foot contact). Both types of packets are optional. If the 'enable type I packets' parameter is set to 0, the type I packets will not be transmitted by the gaitway-3D software as part of the data stream. If the 'enable type I packets' parameter is set to 1, only the header (i.e. global information about each packet) will be transmitted. If the 'enable type I packets' parameter is set to 2, the header and each sample of the type I packet will be transmitted. The same control is available for type II packets transmission.

Command	**Start data streaming**	
Command ID	`startDS`	
Parameters	**Value**	**Description**
Parameter 1	100, 200, 250, 400, 500, 1000, 2000	**Sample frequency** Sample frequency, in Hertz, expressed in ASCII.
Parameter 2	0 to 1800	**Number of seconds** Total number of seconds of data to transmit before stopping the data stream. Zero specifies an indefinite data streaming.
Parameter 3	0, 1, 2, 3	**Enable start/stop trigger** 0 = Start and stop triggers are disabled. Data streaming starts immediately and stops when number of samples is reached or `stopDS` command is received. 1 = Start trigger is enabled, stop trigger is disabled. Data streaming starts when trigger is received and stops when number of samples is reached or `stopDS` command is received. 2 = Start trigger is disabled, stop trigger is enabled. Data streaming starts immediately and stops when trigger is received or number of samples is reached or `stopDS` command is received, whichever comes first. 3 = Start and stop triggers are enabled. Data streaming starts when trigger is received and stops when trigger is received or number of samples is reached or `stopDS` command is received, whichever comes first.
Parameter 4	0 or 1	**Enable sync out** 0 = Sync output is disabled, set to its default value during data streaming. 1 = Sync output enabled, controlled according to gaitway-3D software settings during the data streaming.
Parameter 5	0, 1, 2	**Enable type I packets** 0 = Type I packets are not transmitted. 1 = Only the header of type I packet is transmitted. 2 = Header and all samples of type I packets are transmitted.

Parameter 6	0, 1, 2	**Enable type II packets** 0 = Type II packets are not transmitted. 1 = Only the header of type II packet is transmitted after each step. 2 = Header and all samples of type II packets are transmitted after each step.
Response	Acknowledgement Binary packets of type I according to Table 11 Optional: binary packets of type II according to Table 14	
Example transmission		
Third party software transmission `startDS 1000 0 0 0 2 0<CR><LF>`	gaitway-3D software transmission `0x001A 0x0006 startDS 1000 0 0 0 2 0` Binary packets of type I according to Table 11	
Example transmission		
Third party software transmission `startDS 1000 0 0 0 2 2<CR><LF>`	gaitway-3D software transmission `0x001A 0x0006 startDS 1000 0 0 0 2 2` Binary packets of type I according to Table 11 Binary packets of type II according to Table 14	
Example transmission		
Third party software transmission `startDS 1000 0 1 0 2 2<CR><LF>`	gaitway-3D software transmission `0x001A 0x0006 startDS 1000 0 1 0 2 2` Wait for force amplifier to receive start trigger Binary packets of type I according to Table 11 Binary packets of type II according to Table 14	
Example transmission		
Third party software transmission `startDS 800 0 0 0 2 2<CR><LF>`	gaitway-3D software transmission `0x0019 0x0006 startDS 800 0 0 0 2 2`	

The content of type I data packets is defined in Table 11. Each packet starts with a header followed by a number of samples. The header of type I packets consists of 16 bytes according to the format specified in Table 12. The typical number of samples in the packet is a function of the sample frequency as shown in Table 10, although the packet size is specified in the header of each packet and the third party application should not rely on the streaming a fixed packet size. Note that the last packet may contain smaller number of samples if a fixed data streaming duration is requested or if the acquisition is interrupted unpredictably (e.g. via a stop trigger). If packets type I are requested according to the 'Enable type I packets' parameter of the `startDS` command, a type I packet (or only its header) is transmitted via the data stream at regular intervals. The packet number is reset to 1 for the first packet of the data stream and incremented after each packet transmission. The packet sample data consists of 36 bytes according to the format specified in Table 13. The raw data, calibrated and filtered according to the data streaming settings, are included for each sample. Unavailable data, if any, are coded as `NaN`.

Table 10. Typical number of samples per type I packet.

Sample frequency	Samples per packet	Sample frequency	Samples per packet
100	4	500	20
200	8	1000	40
250	10	2000	80
400	16		

Table 11. gaitway-3D data stream packet type I content.

Field number	Field name	Number of bytes	Description
1	Type I packet header	16	See format described in Table 12.
2	Sample 1 data	36	See format described in Table 13.
3	Sample 2 data	36	See format described in Table 13.
…	Sample … data	36	See format described in Table 13.
n+1	Sample *n* data	36	See format described in Table 13.

Table 12. gaitway-3D data packet type I header content.

Field number	Field name	Type	Size (bytes)	Description
1	Packet size	U16	2	Size of packet in bytes (including 2 bytes of Packet size field).
2	Packet type	U16	2	Set to 1 indicating type I packet.
3	Packet ID	U32	4	Packet number, reset to 1 at the beginning of each data stream and incremented for each type I packet transmitted during the data streaming.
4	Padding	-	8	Padding bytes set to `0x00`.

Table 13. gaitway-3D data packet type I sample content.

Field number	Field name	Type	Size (bytes)	Description
1	Fz	SF32	4	Total vertical force, along Z axis, in Newton.
2	Fy	SF32	4	Total fore-afterwards force, along Y, axis in Newton.
3	Fx	SF32	4	Total lateral force, along X axis, in Newton.
4	COPy	SF32	4	Fore-afterwards coordinate of the center of pressure relative to the referential origin (i.e. the rear right corner of treadmill frame) along Y axis, expressed in meter.
5	COPx	SF32	4	Lateral coordinate of the center of pressure relative to the referential origin (i.e. the rear right corner of treadmill frame) along X axis, expressed in meter.
6	Tz	SF32	4	Frictional torque, around Z axis, in Newton*meter.
7	Tread speed	SF32	4	Instantaneous treadmill speed, expressed in meter per second.
8	Elevation	SF32	4	Treadmill elevation setting expressed in percent grade.
9	Heart rate	U16	2	If the heart rate sensor signal is available, this field reports the patient heart rate expressed in beats per minute. If the signal is not present, the sensor reports a value of zero.
10	Digital inputs	U16	2	Digital input and output signals from the force amplifier binary coded as: Bit 15 to bit4: set to `0`. Bit 3: Sync output. Bit 2: Zero input. Bit 1: Aux input. Bit 0: Trigger input. Where `1` codes a high (i.e. 5V) signal and `0` codes a low (i.e. 0V) signal.

The content of type II data packets is defined in Table 14. Each packet starts with a header followed by a number of samples. The header of type II packets consists of 32 bytes according to the format specified in Table 15. The number of samples in the packet is a function of the step frequency; each packet contains the number of samples acquired during one step period. If packets type II are requested according to the 'Enable type II packets' parameter of the `startDS` command, a type II packet (or only its header) is transmitted via the data stream after each step period. However, to maintain the data synchronicity with other data flows, default type II packets are also sent periodically (typically every 200ms) when no gait step can be detected. Therefore only the digital inputs (field number 2 Table 16) are filled in those default type II packets (other unavailable data are coded as `NaN`) and the header reports a Gait type as '2 otherwise' (see Table 15).

The packet number is reset to 1 for the first packet of the data stream and incremented after each packet transmission. The packet sample data consists of 44 bytes according to the format specified in Table 16. The left and right foot contact signals, computed from the raw data according to RD 8 and RD 9 are included for each sample. Unavailable data, if any, are coded as `NaN`.

Table 14. gaitway-3D data stream packet type II content.

Field number	Field name	Number of bytes	Description
1	Type II packet header	32	See format described in Table 15.
2	Sample 1 data	44	See format described in Table 16.
3	Sample 2 data	44	See format described in Table 16.
…	Sample … data	44	See format described in Table 16.
n+1	Sample *n* data	44	See format described in Table 16.

Table 15. gaitway-3D data packet type II header content.

Field number	Field name	Type	Size (bytes)	Description
1	Packet size	U16	2	Size of packet in bytes (including 2 bytes of Packet size field).
2	Packet type	U16	2	Set to 2 indicating type II packet.
3	Packet ID	U32	4	Packet number, reset to 1 at the beginning of each data stream and incremented for each type II packet transmitted during the data streaming.
4	Gait type	U16	2	0 for walking, 1 for running, 2 otherwise
5	Contact side	U16	2	0 for left foot contact, 1 for right foot contact, 2 otherwise
6	Step count	U32	4	Subsequent step count, reset to 1 at the beginning of each data stream and at each change of gait type.
7	Padding	-	16	Padding bytes set to `0x00`

Table 16. gaitway-3D data packet type II sample content.

Field number	Field name	Type	Size (bytes)	Description
1	Foot contact	U16	2	0 = aerial phase (running) 1 = single contact phase (walking or running) 2 = double contact phase (walking)
2	Digital inputs	U16	2	Digital input and output signals from the force amplifier binary coded as: Bit 15 to bit4: set to 0. Bit 3: Sync output. Bit 2: Zero input. Bit 1: Aux input. Bit 0: Trigger input. Where 1 codes a high (i.e. 5V) signal and 0 codes a low (i.e. 0V) signal.
3	FzL	SF32	4	Left vertical force, along Z axis, in Newton.
4	FyL	SF32	4	Left fore-afterwards force, along Y axis, in Newton.
5	FxL	SF32	4	Left lateral force, along X axis, in Newton.
6	COPyL	SF32	4	Fore-afterwards coordinate of the center of pressure under the left foot relative to the referential origin (i.e. the rear right corner of treadmill frame) along Y axis, expressed in meter.
7	COPxL	SF32	4	Lateral coordinate of the center of pressure under the left foot relative to the referential origin (i.e. the rear right corner of treadmill frame) along X axis, expressed in meter.
8	FzR	SF32	4	Right vertical force, along Z axis, in Newton.
9	FyR	SF32	4	Right fore-afterwards force, along Y axis, in Newton.
10	FxR	SF32	4	Right lateral force, along X axis, in Newton.
11	COPyR	SF32	4	Fore-afterwards coordinate of the center of pressure under the right foot relative to the referential origin (i.e. the rear right corner of treadmill frame) along Y axis, expressed in meter.
12	COPxR	SF32	4	Lateral coordinate of the center of pressure under the right foot relative to the referential origin (i.e. the rear right corner of treadmill frame) along X axis, expressed in meter.

6.3.3. Reset baseline output command

The `resetBO` command reports the command acknowledgment then resets the baseline output for the gaitway-3D force amplifier. This command needs to be sent when no external load is applied to the gaitway-3D; that is, when no patient is standing on the device nor touching the device. The baseline output for an unloaded condition will be stored in the gaitway-3D software and used for subsequent computation of applied loads. The execution of this command lasts between 500 and 1500 milliseconds.

Command	**Stop data streaming**	
Command ID	`resetBO`	
Parameters	**Value**	**Description**
Parameter 1	None	None
Parameter 2	None	None
Parameter 3	None	None
Parameter 4	None	None
Parameter 5	None	None
Parameter 6	None	None
Response	Acknowledgement	
Example transmission		
gaitway-3D software transmission `resetBO<CR><LF>`		gaitway-3D force amplifier transmission `0x000B 0x0006 resetBO` Read and store baseline output for unloaded condition.
Example transmission		
gaitway-3D software transmission `reset<CR><LF>`		gaitway-3D force amplifier transmission `0x0009 0x0015 reset`

6.3.4. Stop data streaming command

The `stopDS` command interrupts any ongoing data streaming and packet transmission, then reports the command acknowledgment. This is the only command that the gaitway-3D software will accept during data streaming. If any other command is received during data streaming the command is ignored and no acknowledgment message will be sent. Nevertheless, the `stopDS` command can be sent without harm when no data streaming is going on but it will only be acknowledged and have no further effect.

The `stopDS` command is acknowledged only after the data hardware acquisition and the data streaming are stopped. Any unsent data will be lost.

Command	**Stop data streaming**	
Command ID	`stopDS`	
Parameters	**Value**	**Description**
Parameter 1	None	None
Parameter 2	None	None
Parameter 3	None	None
Parameter 4	None	None
Parameter 5	None	None
Parameter 6	None	None
Response	Acknowledgement	
Example transmission		
gaitway-3D software transmission `stopDS<CR><LF>`		gaitway-3D force amplifier transmission `0x000A 0x0006 stopDS` Stop data acquisition if ongoing Stop streaming of data packets
Example transmission		
gaitway-3D software transmission `endDS<CR><LF>`		gaitway-3D force amplifier transmission `0x0009 0x0015 endDS` Continue data packets streaming if ongoing

7. Documents

7.1. Applicable documents

The following documents are applicable to the extent they are mandatory for products in all country of the EU.

A.D.	Reference	Iss./Rev.	Date	Title
AD 1	TM-SP-0013-ARS			20160929_cos102999_modification_3d_force_treadmill_150_50_hardware_user_requirement_functional_specification.
AD 2	EN 60335-1	5	2012-10	Household and similar electrical appliances - Safety - General requirements.
AD 3	EN 957-6		2014-06	Stationary training equipment - Part 6: Treadmills, additional specific safety requirements and test methods.

7.2. Reference documents

The following documents give support and background information, but they do not contain formal requirements.

R.D.	Reference	Iss./Rev.	Date	Title
RD 1	20091022_cos100115	1.0	09/07/2009	MCU5 Device Description with examples
RD 2	20091022_cos100115		24/09/2009	h-p-cosmos - coscom v3 overview
RD 3	20091022_cos100115		24/09/2009	h-p-cosmos - coscom v3 protocol (implementation notes)
RD 4	20091022_cos100115		24/09/2009	h-p-cosmos - coscom v3 services notes (basic device control)
RD 5	20091022_cos100115_ XDOP DA 103 20090709	1.0.3	10/11/2006	XDOP Device Architecture
RD 6	TM-MAN-0004-ARS	A4	27/03/2018	Original instruction for use for the gaitway-3D 150_50 instrumentation
RD 7	TM-HO-0013-ARS	A0	04/05/2018	gaitway 3D data streaming approach

R.D.	Reference	Iss./Rev.	Date	Title
RD 8	Gait & Posture 43 (2016) 245–250			Determination of the vertical ground reaction forces acting upon individual limbs during healthy and clinical gait.
RD 9	Gait & Posture 73 (2019) 221–227			A robust machine learning enabled decomposition of shear ground reaction forces during the double contact phase of walking.

DOCUMENT AUTHORSHIP

	Name	Company	Date	Signature
Prepared by:	G. BASTIEN	ARSALIS	2/8/2022	
Checked by:	M. CARBONE	ARSALIS	02/08/2022	
Proj. Man.:	M. PENTA	ARSALIS		

DISTRIBUTION LIST

Quantity	Company	Department	Name
1	THIRD PARTY		
1	ARSALIS		ARCHIVE

CHANGE RECORD

Iss.	Rev.	Date	# Pages	Affected Pages	Description
A	0	11/06/2018	v + 34	All	First issue.

Iss.	Rev.	Date	# Pages	Affected Pages	Description
A	1	27/06/2018	v + 31	2	Clarified section 2.1.
				6	Updated Figure 5.
				8	Updated Figure 7.
				9-10	Updated Figure 8 and section 4.3.
				11	Clarified section 4.4.3.
				16	Updated format of data streaming settings packet in Table 9.
				18-25	Clarified trigger and sync out operation, modified startDS trigger command parameter, modified parameters to make type I packets optional, clarified example transmissions for startDS command, clarified description of type I packets transmission, updated Table 10, modified format of Heart Rate to U16, modified format of Digital inputs to U16 in Table 13, updated values for Gait type and for Contact side in Table 15, clarified ‘foot contact’ vs. ‘step’, added Foot contact field in Table 16 and updated Table 14 in section 6.3.2.
				26	Clarified section 6.3.3.
A	2	18/07/2018	v + 31	11,19,22	Updated rate of type I packets to 25Hz in section 4.4.3, in section 6.3.2 and in Table 10.

Iss.	Rev.	Date	# Pages	Affected Pages	Description
A	3	19/10/2018	V + 32	12	Update return values in section 5.1.
				12	Removed data type U8 from Table 6.
				14	Updated general response format in section 6.2.
				14	Updated definition of acknowledgment packet in Table 8.
				15	Updated example transmission in section 6.3.1.
				16-18	Updated definition of data streaming settings packet in Table 9.
				21	Updated example transmission in section 6.3.2.
				22	Updated definition of data packet type I header in Table 12.
				23	Updated definition of data packet type I sample content in Table 13.
				23-24	Updated size of data type II packets in section 6.3.2 and in Table 14.
				24	Updated definition of data packet type II header in Table 15.
				25	Updated definition of data packet type II sample content in Table 16.
				26	Updated example transmission in section 6.3.3.
				27	Updated example transmission in section 6.3.4.
A	4	10/10/2019	V + 32	2	Updated Figure 2 and section 2.1.
				9	Update LPF setting description.
				10	Update Figure 8.
				18	Update format to char[32] for field number 26 of getDSsettings command.
				21	Updated example transmission in section 6.3.2.
				23	Update type II packets description relative to default empty packets transmission when no gait steps can be identified.
				27	Updated description of the Stop data streaming command.
				23+29	Add RD9: Gait & Posture 73 (2019) 221-227.
A	5	16/03/2021	V + 33	I	Updated first page info
				5-6	Updated the full section for Analog output, Updated Figure 4 and Table 5.
				17	Updated field 4 of Table 9: padding U16 replaced by DS client access authorization.

Iss.	Rev.	Date	# Pages	Affected Pages	Description
A	6	02/08/2022	V + 33	5	Table 4: update Trig In and Aux In description.
				11	Update Figure 8.
				15	Table 8: remove minimum command length.
				18-19	Table9: update description and example value for fields 22,23 and 24. A value of ‘0’ is obsolete for fields 22 and 23.