File storage format

Component of the Pioneer Set

Intended Use

The hardware and software components of the EIT Pioneer Set are intended for laboratory applications, exclusively. They must not be used on humans! Set-up and use of the components is the sole responsibility of the user.

Specifications

The file storage format is made transparent to allow researchers to access each-others research data and share openly their results. We suggest to store files with a name in the following format:

eit_data_yyyy_MM_dd_HH_mm_ss.eit
For instance: eit_data_2011_05_14_23_08_29.eit

The files are stored according to the format given in the following pages. Sample code to read the files can be downloaded from the Swisstom website. The code is written for the commercial software package MATLAB (The MathWorks Inc, Natick, MA, USA).

The general format of the files is:

File header
Data of scan frame #1
Data of scan frame #2
Data of scan frame #3
...
...
Data of scan frame #NFR

Swisstom AG

The vision of Swisstom AG is to become a globally active and leading provider of life saving, non-invasive medical technology for patient monitoring – to the benefit of patients, physicians, caregivers and society.

Swisstom AG was founded in Landquart (Switzerland) in September 2009 by Josef X. Brunner, Stephan H. Böhm and Peter Seitz. Swisstom AG develops innovative medical devices for the monitoring of lung and heart function in ICU patients and patients undergoing general anesthesia. End-users include physicians (primarily intensivists and anesthesiologists) and other health care professionals.

Unlike traditional tomographic methods, Swisstom´s imaging is driven by electrical impedance tomography (EIT). This technology will serve Swisstom as a platform for future product developments.

File header

Data	Symbol	Size [byte]	Data Type	Comments
File format version	FFV	4	Integer	This format = 3
Initial file timestamp	ITS	8	Long	Timestamp of the first frame of the file.
Final file timestamp	FTS	8	Long	Timestamp of the last frame of the file.
Number of frames in file	NFR	4	Integer	Number of data frames written in this file.
File Name	FNM	200	String	entered by the user 100 chars filled with spaces.
File Conditions	FCD	600	String	entered by the user 300 chars filled with spaces.
File Comments	FCM	1200	String	entered by the user 600 chars filled with spaces.
ImageRate	T_IR	4	Float	IMAGE_RATE value
InjectionCurrent	T_IC	4	Float	INJECTION_CURRENT value
Frequency	TP_FRQ	4	Float	EXCITATION_FREQUENCY value
SettlingOn	TP_ST	4	Float	SWITCH_SETTLING_TIME value
InjectionPattern	TP_SP	4	Integer	INJECTION_PATTERN value
NumberElectrodes	TP_NEL	4	Integer	NUMBER_ELECTRODES value
SBC NCO Freq	SP_FRQ	4	Integer	SBC_NCO_F value
SBC DAC Gain	SP_DG	4	Integer	SBC_DAC_G value
SBC DAC Samp.Freq.	SP_DF	4	Integer	SBC_DAC_FS value
SBC IDTA	SP_IDTA	2 * TP_NEL	String	SBC_ST_IDTA value
SBC MDTA	SP_MDTA	2 * TP_NEL	String	SBC_ST_MDTA value
SBC TICLK	SP_TICLK	4	Integer	SBC_TICLK value
SBC TMCLK	SP_TMCLK	4	Integer	SBC_TMCLK value
SBC NPPW	SP_NPPW	4	Integer	SBC_NPPW value
SBC PGA 0 gain	SP_P0G	4	Integer	SBC_PGA0_G value
SBC PGA 1 mode	SP_P1M	4	Integer	SBC_PGA1_M value
SBC PGA 1 gain	SP_P1G	4	Integer	SBC_PGA1_G value
SBC PGA 1 offset	SP_P1O	4	Integer	SBC_PGA1_O value
SBC NIGN	SP_NIGN	4	Integer	SBC_NIGN value
SBC TIGN	SP_TIGN	4	Integer	SBC_TIGN value
SBC NSMP	SP_NSMP	4	Integer	SBC_NSMP value
SBC TSMP	SP_TSMP	4	Integer	SBC_TSMP value
SBC TR	SP_TR	4	Integer	SBC_TR value
SBC NI0	SP_NI0	4	Integer	SBC_NI0 value
SBC NQ0	SP_NQ0	4	Integer	SBC_NQ0 value
SBC NI1	SP_NI1	4	Integer	SBC_NI1 value
SBC NQ1	SP_NQ1	4	Integer	SBC_NQ1 value
SBC NRAW	SP_NRAW	4	Integer	SBC_NRAW value
SBC RAW Mode	SP_RAWM	4	Integer	SBC_RAW_M value
SBC Endianness	SP_END	4	Integer	SBC_ENDIAN value

Data per scan frame or „The Frame“

Data	Symbol	Size [byte]	Data Type	Comments
Frame timestamp	TS	8	Long	Timestamp of the frame
Frame size	TPS	4	Integer	Size in bytes of the frame
Frame start Ident	SID	4	Integer	A frame identifier
Frame end Ident	EID	4	Integer	A frame identifier
Frame code	DEC	4	Integer	Frame code: code 0 stands for a frame as described below.
Frame size	TPSI	4	Integer	Size in bytes of the frame
Frame timestamp	TSI	8	Long	Internal timestamp of the frame
Frame reserve	STATUS	4	Integer	n.a.
Frame error code	ERROR	4	Integer	Error conditions of SBC
Frame reserve	NEC	4	Integer	n.a.
Frame reserve	NST	4	Integer	n.a.
Frame reserve	NBE	4	Integer	n.a.
Frame position data size	NPO	4	Integer	Size in byte of the position sensor data
Frame scanning pattern code size	NSPC	4	Integer	Size in byte of the scanning pattern data
Frame voltage at injection site, data size	NVI	4	Integer	Size in byte of the voltages measured at the injecting electrodes. This size is equal to the number of electrodes times 8 (2 x 32 bit sample).
Frame IQ data size	NIQ	4	Integer	Size in byte of the measured voltages. This size is equal to the square of number of electrodes times 8.
Frame reserve	NEXT	4	Integer	n.a.
Frame reserve	ECP	NEC	Byte[]	n.a.
Frame reserve	STP	NST	Byte[]	n.a.
Frame reserve	BEP	NBE	Byte[]	n.a.
Frame position payload	POP	NPO	Byte[]	Positions measured inside the SensorBeltConnector
Frame scanning pattern payload	SPC	NSPC	Byte[]	Scanning Pattern used for this frame
Frame voltage at injection site, payload	VIP	NVI	Byte[]	All voltages measured at a given electrode while this electrode was injecting current
Frame IQ payload	IQP	NIQ	Byte[]	Image data, I/Q vector Each measurement takes 8 byte (4 byte for I and 4 byte for Q), i.e. 2 integers 32 bit each.
Frame reserve	EXTCn	4	Integer	n.a.
Frame reserve	NEXTn	4	Integer	n.a.
Frame reserve	EXTPn	NEXTn	Byte[]	n.a.

Important note: repeat updating the file header data items IST, FTS, and NFR (see red lines in Table on previous page) until all the NFR data frames are been written.

Raw data analysis

The data acquisition is multiplexed, i.e. all pairs of electrodes are measured sequentially and after each other. The measurement window for each pair of electrodes is devided into three parts: a first part which is ignored, the actual measurement window (focus portion), and a last part which is also ignored. The focus portion is converted into digital format and subsequently demodulated for I and Q.

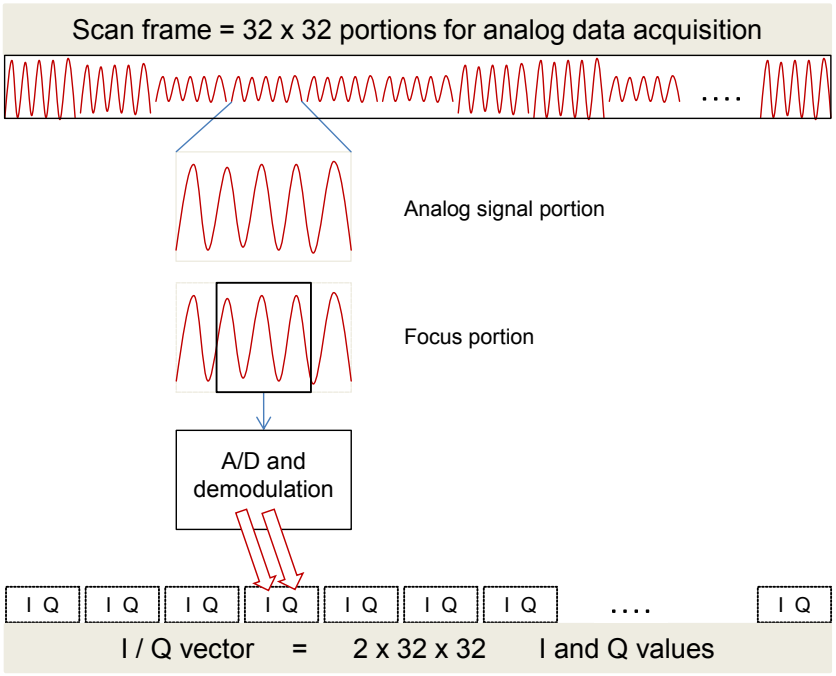

Figure 1: Analysis of analog signals, measured between two electrodes (adjacent or further apart, depending on the injction pattern selected).

For more information

Call: +41 (0) 81 330 0914

mail: info@swisstom.com

Or visit: www.swisstom.com

Swisstom AG

Schulstrasse 1

CH-7302 Landquart, Switzerland