

Review of application programming interface (RANIS API) for controlling hardware of acoustic emission system "RANIS" via Microsoft Visual Studio (C++) and LabVIEW(National Instruments) environment.

1. Introduction.

Application programming interface (RANIS API) is intended for software development, which is capable of controlling hardware of acoustic emission system "RANIS" and controlling acquisition of different data from the system. The API can be used not only for C++ language programming within Microsoft Visual Studio environment, but also for virtual instruments (VI) creation within LABVIEW(National Instrument) environment.

2. API implementation

API was developed as Win-32 based DLL. Standard C++ type variables were used as API function parameters only.

Compilation options:

Library	- multithreaded debugging DLL (/MDd).
Calling convention	<code>__cdecl</code> (/Gd)
Symbols	- multibytes coding.

API was designed as a set of functions. The DLL provides the set of classes and objects, which are used for hardware control. API functions cover the technical details of hardware control. This approach allows to create program modules easily. The API gives possibilities to control practically all hardware settings. The whole number of functions is approximately 100.

Distribution kit contains complex example of hardware initialization, acquisition of all data types, hardware parameter setting, and oscilloscope execution for C++ language. Distribution kit also contains several virtual instruments (VI) for LABVIEW(National Instrument) environment. You can use program solutions for Microsoft Visual Studio 2010 with complex C++ example and help file ("chm"-file) with detailed syntax description of API functions and many small C++ examples.

3.API functionality

The API support initialization and deinitialization of RANIS hardware, start and stop of data acquisition for all three modes of data acquisition, which are developed for nominal RANIS hardware:

1. Mode "Hit descriptions only"
2. Mode "Hit descriptions + waveforms"
3. Mode "Oscilloscope"

Start, implementation and stop of data acquisition are executed for every hardware board separately. API allows to register all data types, which are supported by nominal software for "RANIS" system. API allows to set practically all hardware parameters.

In comparison with nominal software for "RANIS" system, API doesn't support:

1. Sound sources location subsystem.
2. Program data filters.
3. Data visualization subsystem.
4. Sensor array configuration.
5. Different data treatment services.

3.1 Functions of AE-system initialization and deinitialization.

The function group consists of: 1) AE-system initialization function, 2) functions for reading of binary and text settings files, 3) function for writing of text files.

3.2 Functions for data acquisition: start, execution and stop.

The function group consists of: 1) Function for data array size setting, 2) Function for preamplifier state checking 3) Functions for start and stop of data acquisition, 4) Functions for execution of data acquisition: one or two thread.

3.3 Oscilloscope functions

The function group consists of: 1) Functions for start and stop of oscilloscope operation, 2) Functions for different modes of operation of oscilloscope: one or two thread.

3.4 Functions for hardware parameter setting.

The function group is the biggest. The function group consists of functions for threshold, dead time, time-out and prehistory settings, also functions for hardware frequency filter setting.

3.5 Functions for test signal generator.

The function group consists of: 1) Function for pulse package duration setting 2) Function for setting of interval between pulse packages 3) Function for pulse amplitude setting and some other functions.

3.6 Functions for parametrical channel parameter setting.

The function group consists of: 1) Function for setting of parameter input type: voltage or current 2) Function for setting current range 3) Functions for setting of correction coefficients 3) Functions for hand input of parametrical data and some other functions.

4. API examples

There are two groups of examples: several virtual instruments (VI) for LabVIEW environment and an example of program solution for Microsoft Visual Studio 2010 environment.

The VI example group consists of:

1. VI for AE-system initialization and deinitialization demonstration.
2. VI for hit data acquisition demonstration.
3. VI for demonstration of virtual oscilloscope.

4. VI for demonstration of hits, average values and parametric data acquisition:

Binary File: E:\RanisLab_1110\Hardware_Ch08.app
Text File: E:\RanisLab_1110\Hardware_Ch08.txt

Message: Binary configuration file was read successfully.

Reading of binary file Result 1

Message: Board initialization...Search of AE-boards:
1,2
8-channel AE-system was find out.
Board preparation:
1,2
Start of boards:
1,2
Board parameters setting:
1,2
Text configuration file was read successfully.
AE-system initialization was finished successfully.

AE-system initialization Result 0

Message: AE-system deinitalization was finished successfully.

AE-system deinitialization Result 0

Parametrical time Param.values. Average val.times Average values

Time	Param.values.	Average val.times	Channel1	Channel2	Channel3	Channel4
14D5555	0,006174	2E000000	3,670666	3,670666	3,670666	3,670666
29AAAAA	0,006479	5B255555	3,670666	3,670666	3,670666	3,670666
3E80000	0,007090	876AAAAA	3,670666	3,670666	3,670666	3,670666
5355555	0,006479	B4FD5555	3,670666	3,670666	3,670666	3,670666
682AAAA	0,006174	E142AAAA	3,670666	3,670666	3,670666	3,670666
7D00000	0,007700	11022AAAA	3,670666	3,670666	3,670666	3,670666
91D5555	0,007090	139CD5555	3,670666	3,670666	3,670666	3,670666
A6AAAAA	0,007700	164C55555	3,670666	3,670666	3,670666	3,670666
BB80000	0,007090	186A00000	3,670666	3,670666	3,670666	3,670666

Hit data time Hits Hit number 1 Measuring Result 0

Time	Ampl.	Energy	Rise Time	Duration.	Counts	CountsToPeak
28F00FD	23,67	8,25E+3	1,40E+5	2,15E+5	21,00	14,00
C93E4F8	19,23	791,67	1,33E+3	1,33E+3	1,00	1,00
1F3A3B70	23,67	3,66E+3	8,40E+4	1,18E+5	9,00	4,00
3FE5E130	76,30	7,12E+9	1,84E+6	1,34E+7	3,02E+3	433,00
45A3A6E8	51,97	9,62E+5	5,33E+4	2,06E+5	29,00	6,00
505633EA	62,14	1,93E+7	2,44E+5	3,29E+5	51,00	32,00
5B18FFC8	66,11	1,22E+8	7,37E+4	1,39E+6	275,00	18,00
6EBEDEEA	64,40	6,49E+7	4,07E+5	1,13E+6	234,00	102,00
76743E82	30,52	7,03E+3	333,00	2,83E+4	3,00	0,00
79669E4D	63,71	1,47E+7	4,20E+4	1,89E+5	41,00	15,00
87D0B275	62,74	1,34E+7	1,04E+5	3,00E+5	62,00	27,00
9D558FFD	28,78	9,81E+3	8,00E+3	3,20E+4	5,00	2,00
B348ED48	31,97	1,55E+4	8,67E+3	2,37E+4	6,00	2,00
DB2D8710	28,78	9,79E+3	333,00	1,97E+4	5,00	0,00
E21BE7F2	36,93	1,86E+4	3,33E+3	1,30E+4	4,00	1,00
E6EC212A	41,51	1,85E+5	1,23E+5	2,06E+5	33,00	19,00

5. VI for hit and waveform acquisition demonstration:

Binary file: E:\RanisLab_1110\Hardware_Ch08.app
Text file: E:\RanisLab_1110\Hardware_Ch08.txt

Message: Binary configuration file was read successfully.

Reading of binary file Result 1

Message: Board initialization...Search of AE-boards:
1,2
8-channel AE-system was find out.
Board preparation:
1,2
Start of boards:
1,2
Board parameters setting:
1,2
Text configuration file was read successfully.
AE-system initialization was finished successfully.

AE-system initialization Result 0

Message: AE-system deinitalization was finished successfully.

AE-system deinitialization Result 0

Hit times Hits Hit number: 1

Time	Chan	Ampl.	Energy	Rise Time	Duration
2D62F908	1,00	19,23	502,94	1,33E+3	1,33E+3
3BDD64C8	1,00	19,23	586,77	1,33E+3	1,33E+3
416DCA9D	2,00	45,95	1,53E+5	6,67E+3	4,23E+4
6D3F77E0	2,00	80,89	8,54E+9	7,34E+5	2,05E+7
707CBE25	2,00	62,83	2,06E+7	5,37E+4	4,82E+5
85414A9A	2,00	64,18	3,34E+7	7,69E+5	9,33E+5
8DCFA12A	2,00	31,27	1,92E+4	8,00E+3	2,93E+4
91125DE0	2,00	66,01	1,16E+8	5,37E+5	1,31E+6

Waveform №0 Plot 0

6. VI for demonstration of hardware parameter settings:

Binary file: E:\\RanisLab_1110\\Hardware_Ch08.app

Text file: E:\\RanisLab_1110\\Hardware_Ch08.txt

Message
Binary configuration file was read successfully.

Reading of binary file Result 1

Message
Board initialization...Search of AE-boards:
1,2
8-channel AE-system was find out.
Board preparation:
1,2
Start of boards:
1,2
Board parameters setting:
1,2
Text configuration file was read successfully.
AE-system initalization was finished successfully.

AE-system initialization Result 0

Message
AE-system deinitalization was finished successfully.

AE-system deinitialization Result 0

This VI is intended for demonstration AE-system parameter adjustment. Stop

Thresholds, dB

Channel	Threshold, set	To set	Threshold, get
1	45	To set	44,9598
ResultSet	Message (Set)		
0			
ResultGet	Message (Get)		
0			

Dead Time, msec

Channel	DeadT, set	To set	DeadT, get
1	3500	To set	3500
ResultSet	Message (Set)		
0			
ResultGet	Message (Get)		
0			

Prehistory, msec

Channel	PreH, set	To set	PreH, get
1	24	To set	24
ResultSet	Message (Set)		
0			
ResultGet	Message (Get)		
0			

Event time-out, msec

Channel	TimeO, set	To set	TimeO, get
1	50	To set	50
ResultSet	Message (Set)		
0			
ResultGet	Message (Get)		
0			

The same Win32-based DLL "RanisLab.dll" is used both C++ (Microsoft Visual Studio) example and all VI's. As a result, it is possible to create new C++ module, test it, and create VI after that.