April 9, 2013

MCAP-CR Simulator Prerelease v0.2 (Windows x86binary executable& source code) User's Guide

0. Purpose of distribution

This software is to simulate response of standard MCAP-CR (including single & double bass-reflex loudspeaker systems).

Algorithm of simulation is all documented and distributed from http://mcap.web.fc2.com .

1. License

Users agree to GPL for using this software. Details of GPL will be found in link below:
http://www.gnu.org/licenses/licenses.en.html#GPL

2. Terms and Conditions to use the software

Users agree to the following conditions:

i. Mathematical models and algorithms used in this software have practical assumptions, so that this software does not bring exact solutions.
ii. This software bugs either known or unknown.
iii. Users do not claim for any loss or complain as a result to have used this software.
iv. Users do not use this software for commercial purpose.
v. Users understand that this software code should not depend on particular platform, so that users do not modify this code for particular commercial development kit such as Microsoft Visual Studio. Attached program code can be compiled on either Windows or Linux platform using Qt SDK.
vi. Users do not use this software for sound quality evaluation.

3. Functions of this software

- Calculate displacement (then velocity) of masses of standard MCAP-CR, single and double bass-reflex loudspeaker systems.
- Users choose input signal out of sinusoidal, linear sweep, or random. Force is used as input signal for simplicity.
- Users set damping coefficient of each mass.
- Display time series response plot.
- Calculated results are saved as ASCII text file in CSV format.

Users can refer to source code for more details.

4. Preparation to use

4.1 Windows Executable Files

1. Create a folder to save executable files
2. Extract downloaded zip file and copy following file to designate folder.
    1. Windows executable file (with *.exe extension)
    2. libgcc_s_dw2-1.dll
    3. mingwm10.dll
    4. QtCore4.dll
    5. QtGui4.dll
3. Create shortcut of *.exe file to desktop or start up menu for easy software launch (not required but good for practical use)

4.2 Compiling source code（Not required if you use executable file）

1. Install Qt SDK, if not installed yet.
2. GCC for Linux（for Windows. install MinGW）, if not installed yet.

3. Create project folder (i.e. /home/yourname/mcap)
4. Copy the following files the project folder.
    1. mcapcr.pro
    2. dialog.cpp
    3. dialog.h
    4. dialog.ui
    5. main.cpp
    6. moc_dialog.cpp
    7. moc_qcustomplot.coo
    8. qcustomplot.cpp
    9. qcustomplot.h
    10. ui_dialog.h
5. Startup Qt SDKand open mcapcr.pro.
6. Build the project and create executable file.

Note: For MinGW, GCC and Qt, read the software manuals.

5. Basic Software Operation

5.0 Start up the simulator

For Windows System, double-click the executable files, or short-cut from start menu or desktop that you created manually.

For other systems, execute executable file from command line window or file manager program.

5.1 Outline of Operation

Fig.1 shows simulator start up window. Important parts are marked color square and short explanations are given.

5.1.1 Common Operation Panel

Squared right green (upper half of the window) of Fig.1 is shown all the time, if any tab is selected.

(1) Vector Sum Option

This option is used when you see output file for further Fourier Transform. “All the ducts” option is recommended.

(2) Input Frequency Option

Choose input signal from the followings:

Sinusoidal

Users can set input frequency by 1Hz step.

Linear Sweep

Input signal is set as linear sweep. Sweep rate is set at “Sweep Rate” option.

Random

Input signal is set as random.

(3) Plot Selection

In “Normalized graph”, check the mass you want to see the velocity. SumV option means weighted sum of all the masses. Note that when you check all ducts, it may not be easy to see all the curves and calculation takes longer. It is recommended that see only SumV and membrane, and if only you think it is necessary, check some of ducts that you want to see.

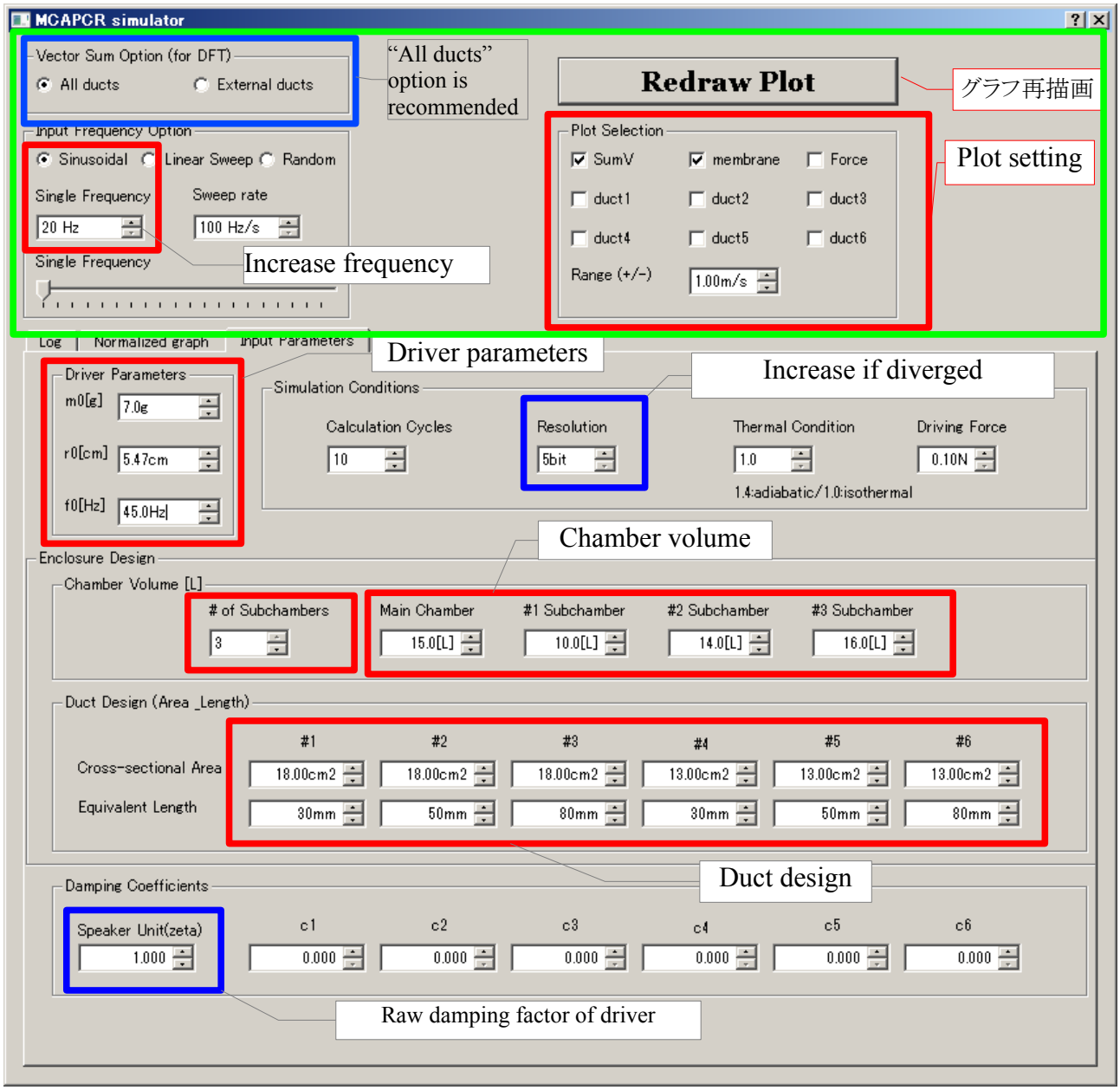

Fig.1 Main Window

5.2 Functions of Tabs

There are Log, Normalized graph, and Input Parameters tabs as seen in Fig.1.
Purpose of each tab is shown below:

(1) Log

Calculation process log is displayed. This is used for debugging purpose.

(2) Normalized graph

Show plots of masses. Open this tab after all the parameters and simulation condition is set.

(3) Input Parameters

Set all the parameters and simulation conditions.

5.3 Driver Parameters

Set dynamic parameters of driver: m_0 , r_0 ,and f_0 in specified units. See manual or catalog of the driver unit.

5.4 Simulation Conditions

Number of calculation cycles, time resolution, thermal condition, and amplitude of given force are set in this section.

(1) Calculation Cycles

This means how many terms you want to see. When you set input frequency, term is calculated as 1/frequency. If you set 10, calculation time window is set [0, 10/frequency]. This is valid for sinusoidal option only.

(2) Resolution

Resolution is defined in bit unit. If you set resolution be 5bit, then actual time resolution is term/32. 5bit is generally okay, but if calculation result diverged, then increase resolution for better result.

(3) Thermal Condition

Input either 1.4 (adiabatic) or 1.0 (isothermal) as thermal condition. Adiabatic condition is generally recommended; however, there is no perfect adiabatic condition, so based on my experience, isothermal condition should be considered.

(4) Driving Force

Amplitude of input force is set. 0.1N is enough for small drivers, but you may increase this if you do not see enough response.

5.5 Enclosure Design

(1) # of Subchambers

You may choose up to three subchambers. Follow the numbering rule shown in Fig.2.

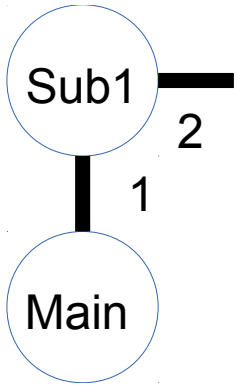

Fig.2-1 n=1

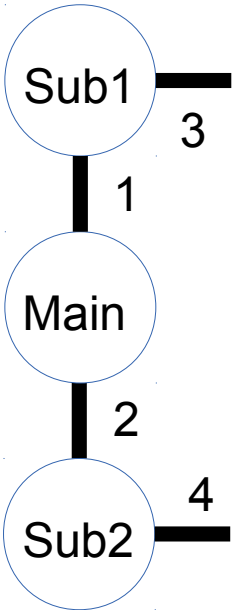

Fig.2-2 n=2

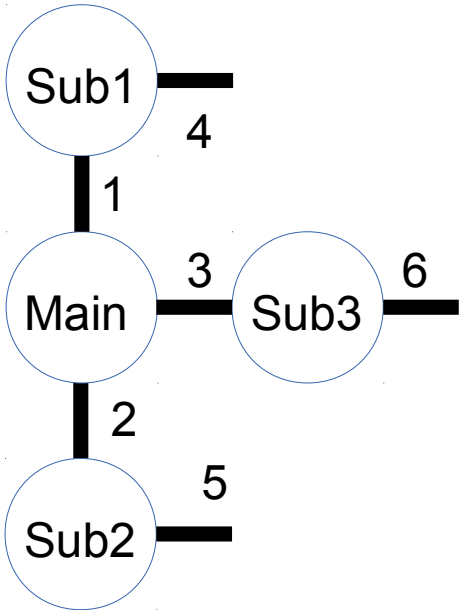

Fig.2-3 n=3

(2) Chamber Volume

Input designed chamber volume in specified unit. Note that input values that are not applicable are ignored if you choose number of subchambers 1 or 2.

(3) Duct Design

Input cross-sectional area and length of each duct in specified units. Follow numbering rule defined in Fig.2.

Input values in not applicable boxes are ignored.

Application to Single Bass-Reflex system.

Users may approximate single bass-reflex model using double bass-reflex option. In this case, maximize the capacity of subchamber 1, then effect of subchamber is reduced enough. Duct 2 will not affect the result, if volume of subcahmber is big enough. You will see velocity of duct2 is small enough using this tip.

5.6 Damping Coefficients

Damping factor of raw speaker driver is set. It is better if effect of main chamber is considered, so this will be modified at next releqase.
Damping coefficient of each duct will be set at user's design. There is no guideline to set damping coefficients. Getting right values of damping coefficients will not be easy, unless you are expert of fluid dynamics. I need also to study.

5.7 “Normalized graph”

This tab is to display simulation results. You may change input frequency while viewing the plot. This function is very useful to simulate your design.

6.0 Questions and requests

For simulation algorithms, read the documents in the following page:
http://mcap.web.fc2.com/documents.html .
For other questions or requests, send emal to: mcapspeakers@gmail.com

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