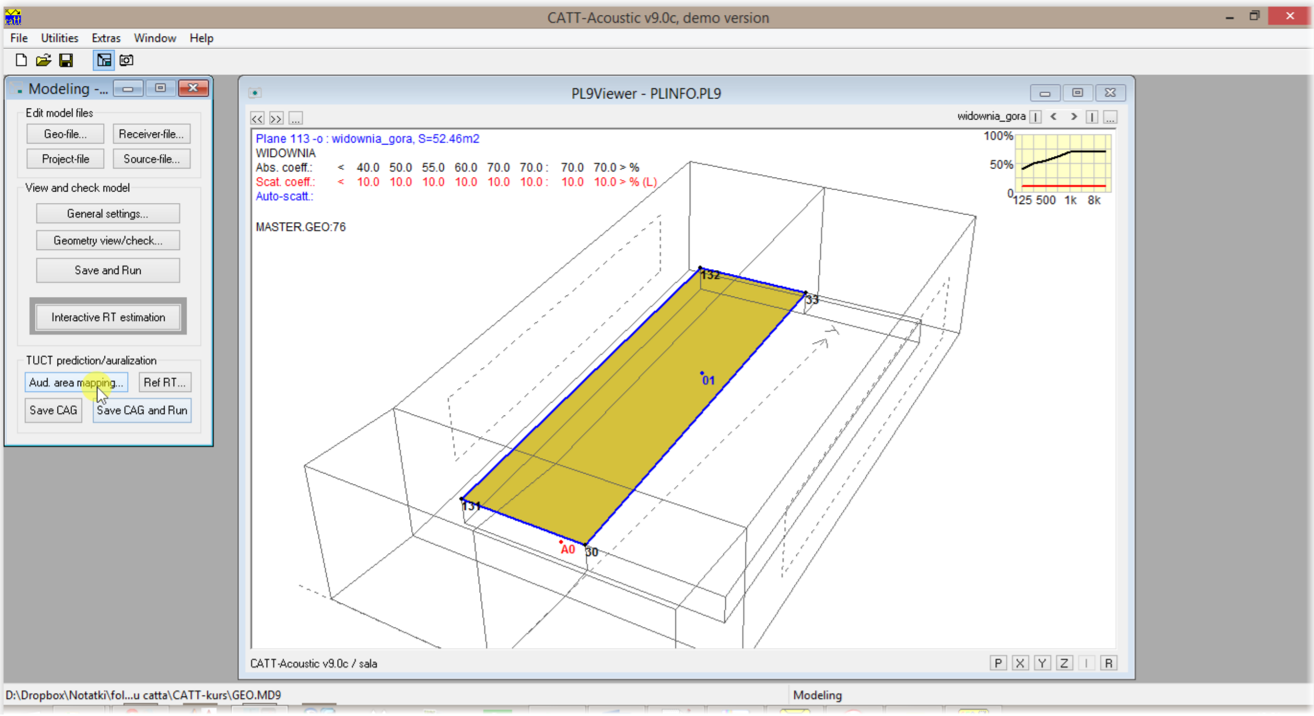
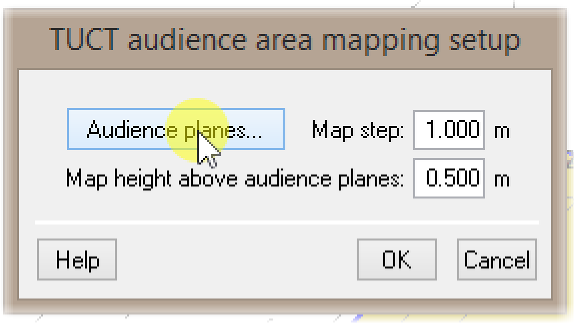
TUCT prediction model

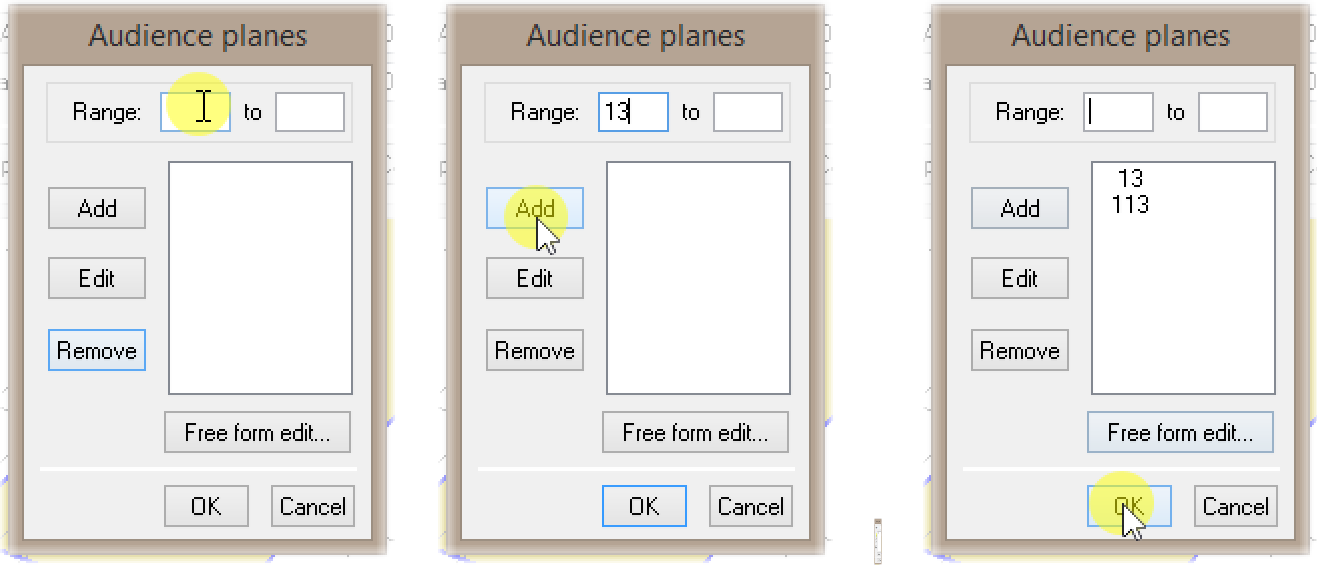
The first step in using the TUCT module is defining the audience area. To do that we need to choose an option called *Aud.area mapping:*



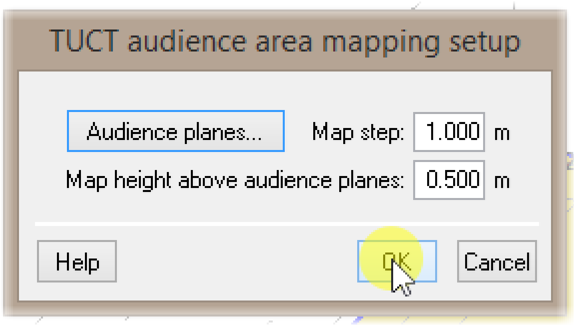
And next, in the new window we click *Audience planes*.



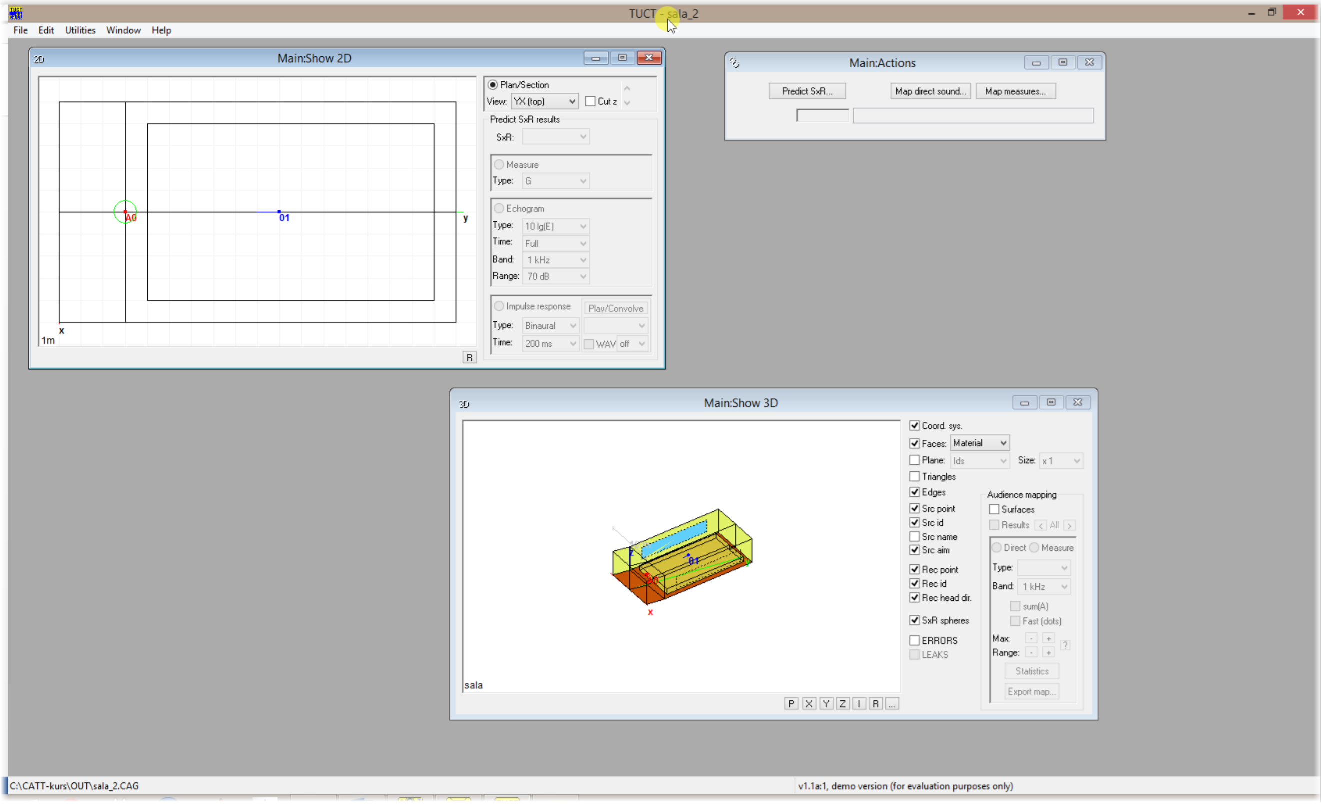
In the windows below we should give the numbers of planes over which the audience area surface will be created (the receivers for simulation will be placed there).



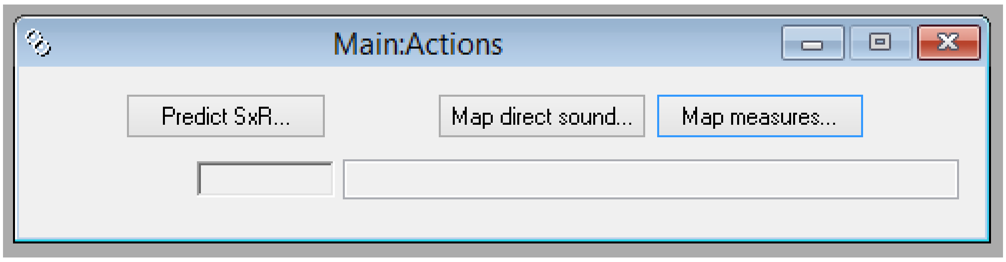
After accepting the changes with the OK button we can change the point's density in the simulation (the Map step option) – it significantly changes the simulations length.



We open the main TUCT window by choosing the



It consists of three windows: *Main:Show2D*, *Main:Show3D* oraz *Main:Actions*.



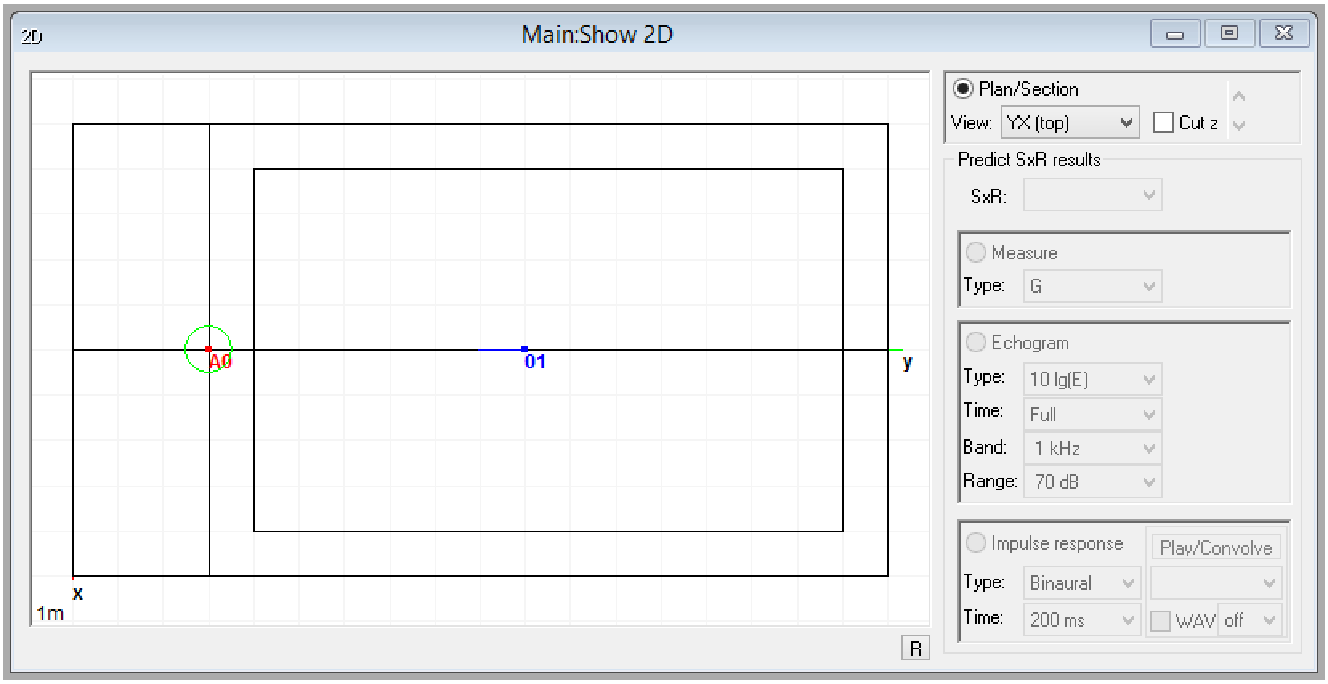
The Main:Actions windows allows us to pick three types of simulation:

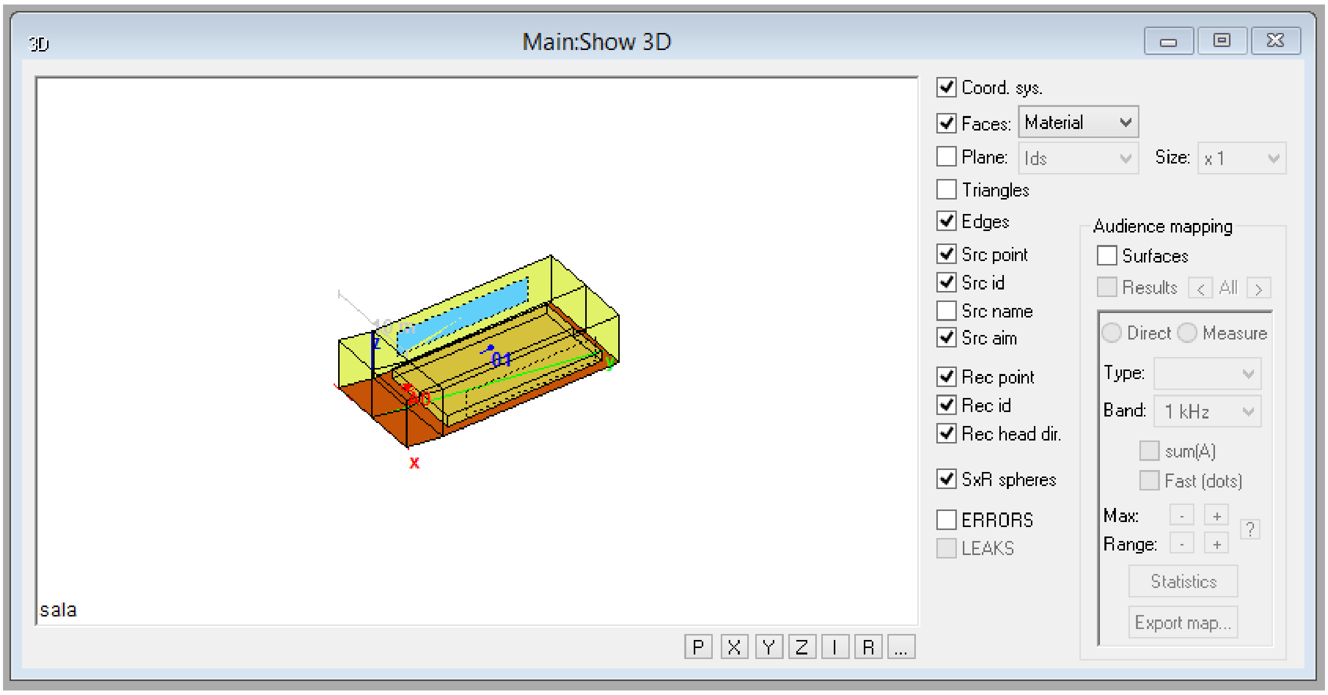
Predict SxR – prediction of Echograms and impulse responses for each source-receiver combination by the use of one of 3 algorithms with different accuracy and computation complexity.

Map measures – prediction of acoustic parameters on a predefined audience area.

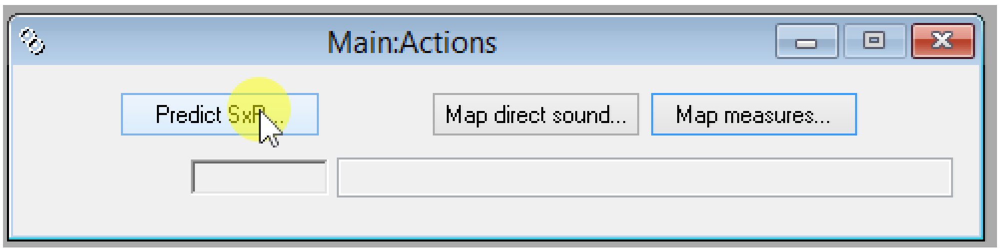
Map direct sound – Prediction of the acoustic pressure level on a predefined audience area.

The results of the simulations above can be represented in a 2D or 3D form in the windows shown below – Main:Show 2D and Main:Show 3D.

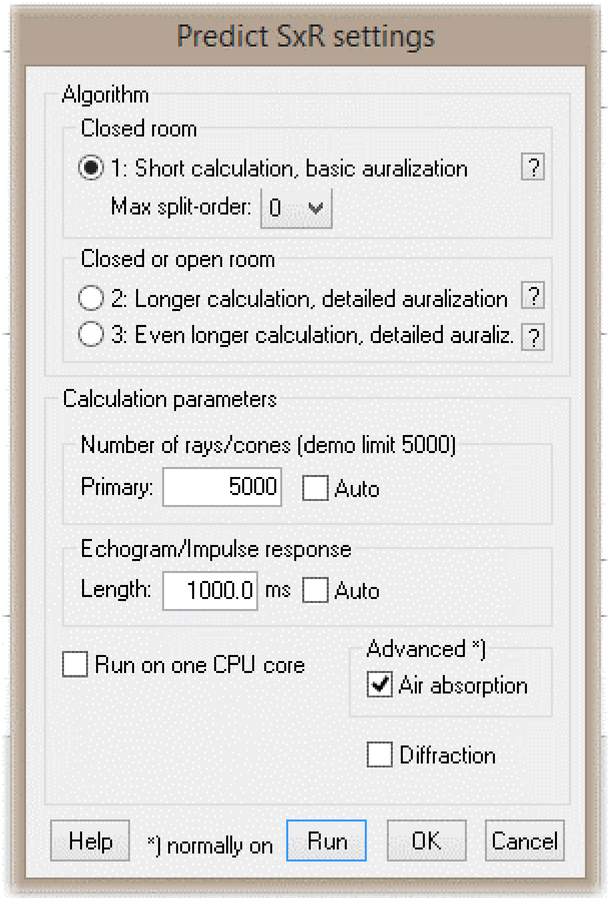




To calibrate the model we must first conduct the computations. In order to do that we must pick an option



We arrive at the settings window:



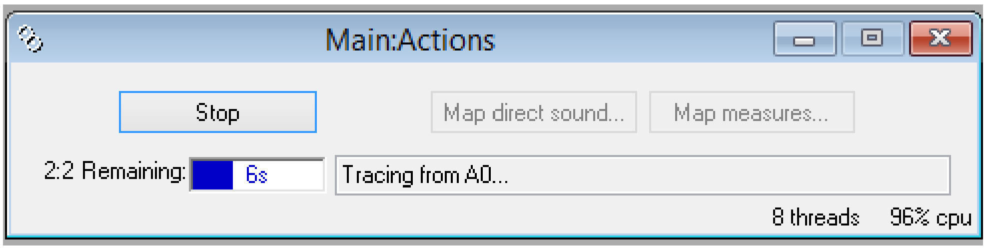
The *Algorithm* section is responsible for the computation algorithm – the first one is usually enought for our uses, we might be forced to use the second one for more comlex computations.

The *Calculation parameters* section allows us to pick a number of generated and traced rays (it is prudent to pick the *Auto* function) and the length of the generated impulse response (at least 3/4 of the reverb time calculated in our measurements – it also affects the computation time).

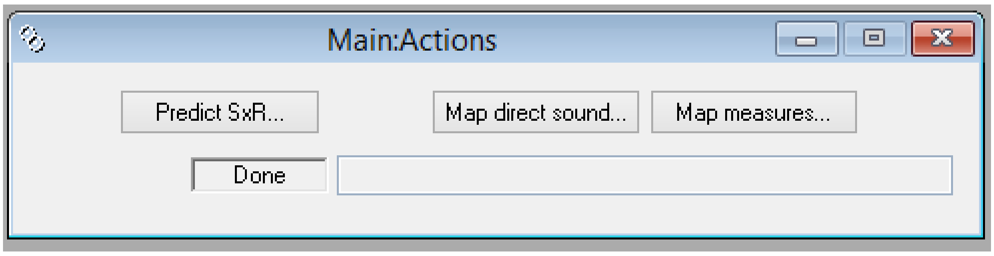
WARNING! In the demo version of CATT-Acoustic that number is capped at 5000 – it does not allow to conduct credible simulations in most rooms. We must calibrate the model using the full version.

After clicking

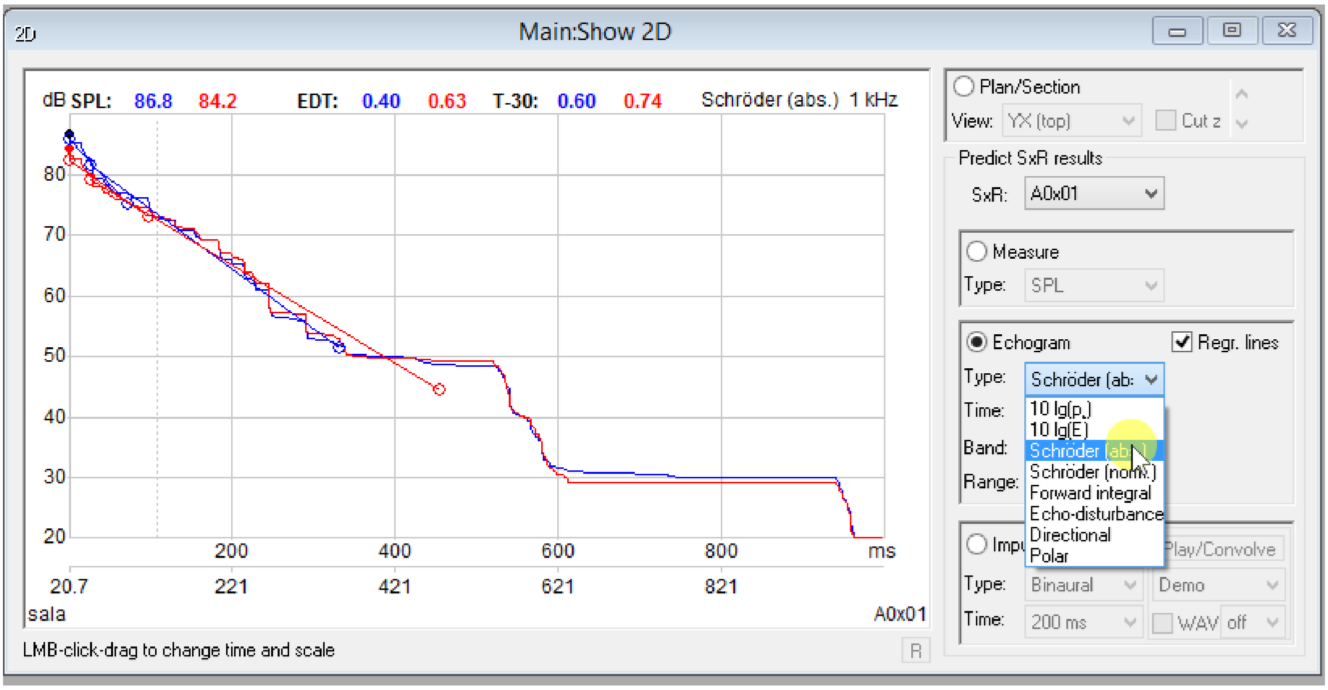
the program conducts the computations. The more sources and points we have defined and the more complex the computations algorithm, the longer they take. It is an adequate moment to brew some tea, for the computations might take as long as a few hours.



After the simulation is over the progress bar is replaced by a Done sign.

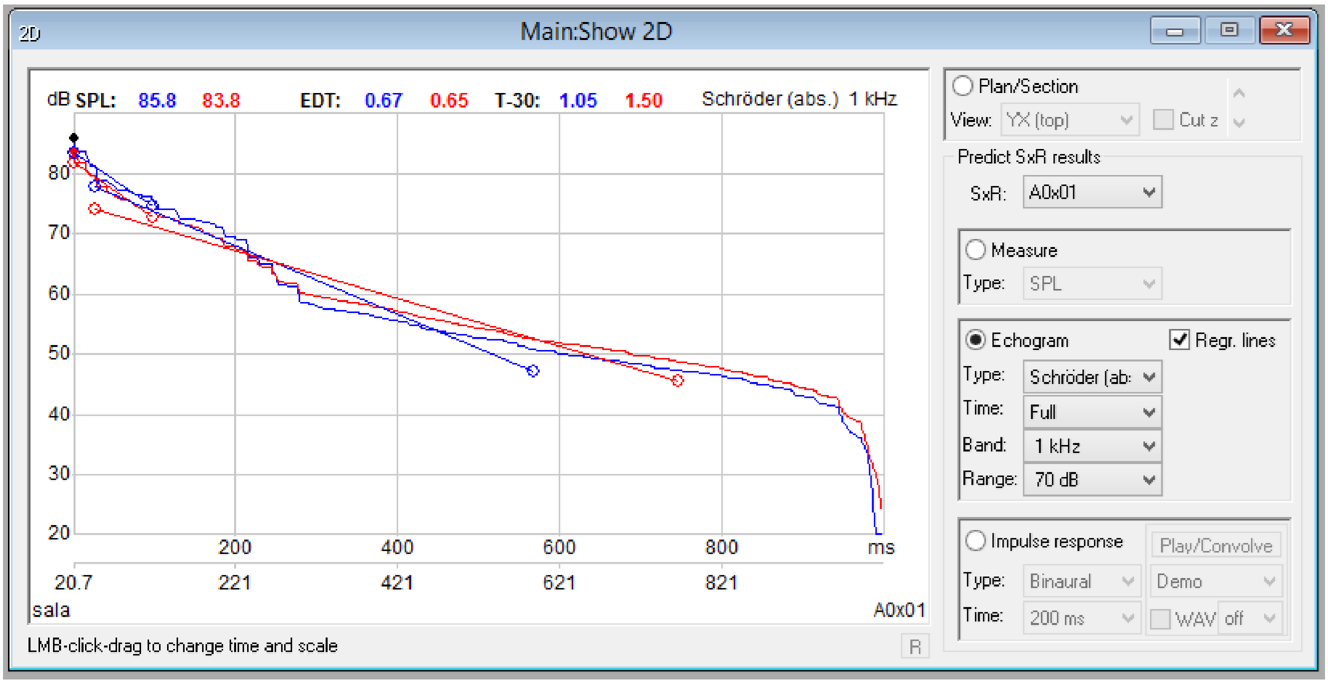


It is now worthwhile to check if the computed curve is even. In order to do that in the Main:Show 2D we choose:

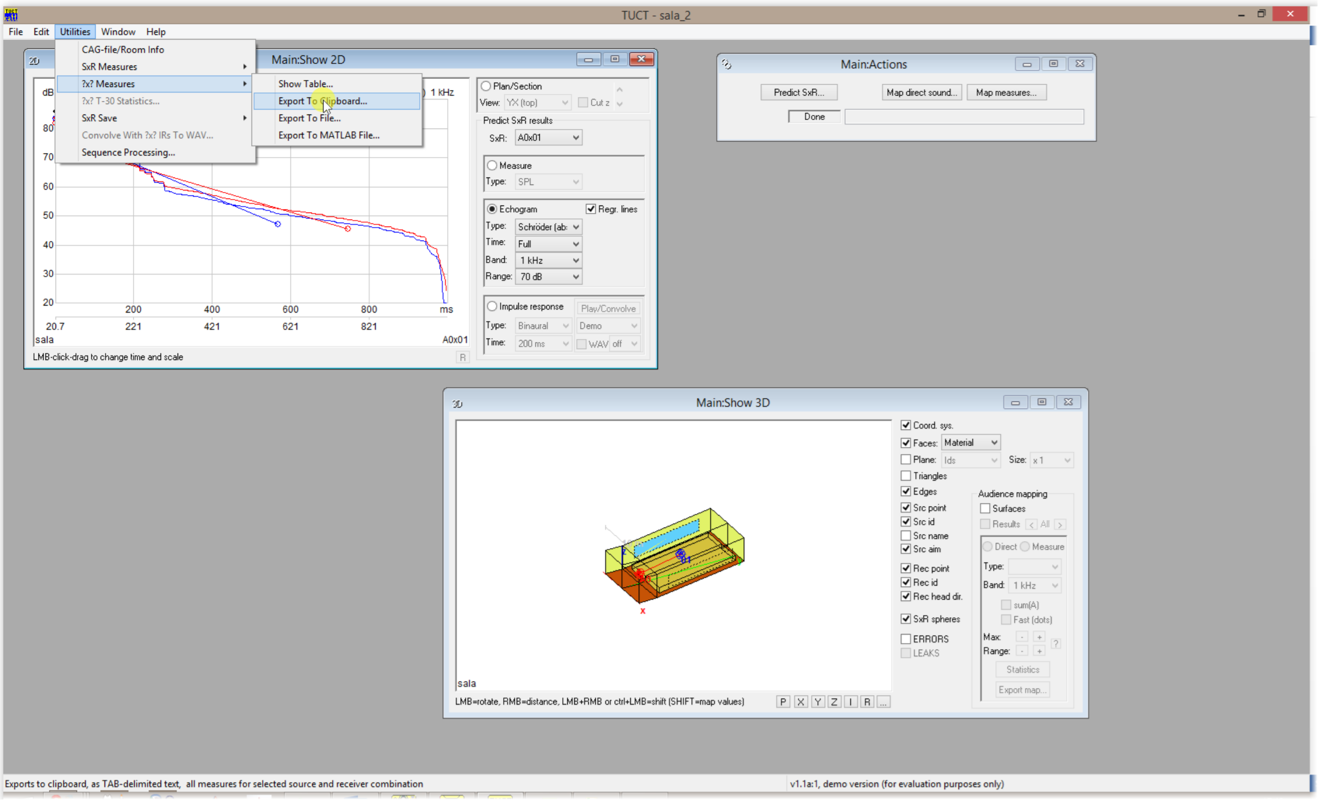


As we can see it is very jagged, in practice with the simulation parameters chosen like that we will be receiving different results in every simulation – it will successfully prevent us from calibrating the model. A solution might be to pick a more accurate computation algorithm or to increase the number of rays.

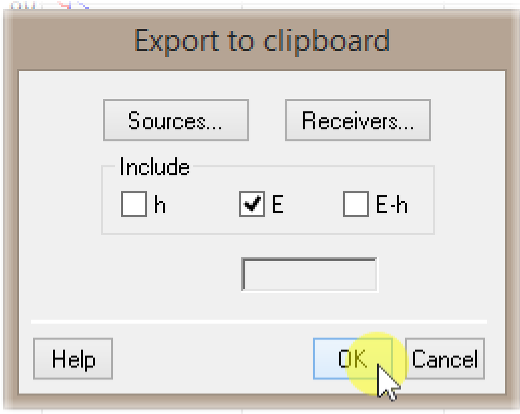
Repeating the computations (choosing *Predict SxR* or the 2nd algorithm) allows us to get much better results:



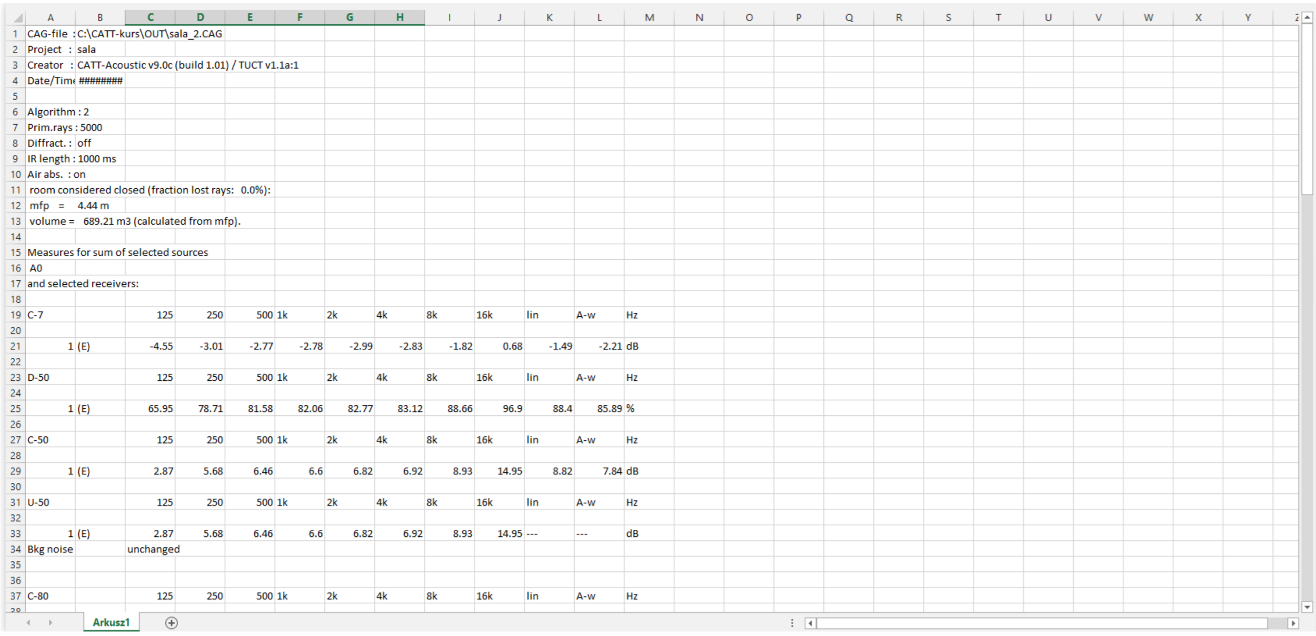
If we can get an even decay curve we can save the computed reverb times, for example in a form of an Excel sheet – to do so we pick:



In the window that has appeared we can choose, for which sources and receivers should the program save the computed results. We disable the h i E-h options, enabling only E (the echogram data) and confirm by clicking OK.



Next we launch the calculation sheet and we paste the contents of our clipboard:



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	CAG-file :	C:\CATT-kurs\OUT\sala_2.CAG											
2	Project :	sala											
3	Creator :	CATT-Acoustic v9.0c (build 1.01) / TUCT v1.1a:1											
4	Date/Time	#########											
5													
6	Algorithm : 2												
7	Prim.rays : 5000												
8	Diffract. :	off											
9	IR length : 1000 ms												
10	Air abs. : on												
11	room considered closed (fraction lost rays: 0.0%):												
12	mfp = 4.44 m												
13	volume = 689.21 m3 (calculated from mfp).												
14													
15	Measures for sum of selected sources												
16	A0												
17	and selected receivers:												
18													
19	C-7		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
20													
21	1	(E)	-4.55	-3.01	-2.77	-2.78	-2.99	-2.83	-1.82	0.68	-1.49	-2.21	dB
22													
23	D-50		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
24													
25	1	(E)	65.95	78.71	81.58	82.06	82.77	83.12	88.66	96.9	88.4	85.89	%
26													
27	C-50		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
28													
29	1	(E)	2.87	5.68	6.46	6.6	6.82	6.92	8.93	14.95	8.82	7.84	dB
30													
31	U-50		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
32													
33	1	(E)	2.87	5.68	6.46	6.6	6.82	6.92	8.93	14.95	---	---	dB
34	Bkg noise		unchanged										
35													
36													
37	C-80		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz

Arkusz1

Here we can find detailed simulation data and the calculated parameter values. We are interested in the mean reverb time values T20 (we should skip the next part of the sheet):

52													
53	EDT		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
54													
55	1	(E)	0.88	0.69	0.66	0.65	0.63	0.53	0.34	0.22	0.74	0.79	s
56													
57	T-15		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
58													
59	1	(E)	0.96	0.91	0.96	0.97	0.96	0.89	0.66	0.26	0.78	0.77	s
60													
61	T-20		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
62													
63	1	(E)	0.99	0.86	0.85	0.89	0.84	0.79	0.66	0.28	0.86	0.87	s
64	--												
65		(E)	0.99	0.86	0.85	0.89	0.84	0.79	0.66	0.28			
66													
67	T-30		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
68													
69	1	(E)	1.16	1	1.01	1.5	0.98	0.8	0.59	0.32	1.23	1.26	s
70	--												
71		(E)	1.16	1	1.01	1.5	0.98	0.8	0.59	0.32			
72													
73	LF		125	250	500	1k	2k	4k	8k	16k	lin	A-w	Hz
74													
75	1	(E)	25.22	25.43	25.99	26.21	26.74	26.39	24.15	17.99	23.06	24.9	%
76													

We only have one receiver in our model, when there are more of them in the marked region (under the short-dashed line) the mean reverb time value is located. Those are the numbers that must fit in our +- 5% deviation of those acquired through measurements.

We calibrate the model by changing the absorbance and scattering coefficients for the materials placed on surfaces bordering the model. We should remember that to adjust the absorbance characteristic so that it is compatible with the physical characteristics of the material (inter alia the growing absorbance characteristic for the suspended ceilings and draperies, selective suppressing for the resonant acoustic treatments). The real impulse response measurements of an investigated room were probably conducted without the audience, which is why the absorbance coefficients of the audience block must conform such a situation.

Useful hints:

- While calibrating the model it is useful to use the material's statistics generated by the Interactive RT estimate tool
- The absorbance of the surface located opposite the scene is important.
- It is worth to stay focused on large surfaces, like the floor and ceiling.

After calibrating the model we can go in for the assessment of the interior's acoustic depending on the object's purpose.