

# The Contributions of Tone Spectral Components of Separate Principal Chorus Stops to the Spectra of Plena of St. Michaëlskerk Organ

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## Introduction

In various historic epoch organ builder dealt with the problem of the room versus the instrument in a different way. This approach is mostly evident on the sound of the organ plena. To be possible to deal with the approach of the individual organ-builder, we dealt with the possible of the studies of the plenum harmonics composition with the harmonics of the separate plenum stops. For the occasion we made the acoustic documentation of the Schnitger's organ in St. Michaëlschurh in Zwolle in the Netherlands, which is regarded as exemplary piece of successful instrument. In order to the acoustic documentation we apply MARC documentation method 3+3 [1] or 8+1, which is still in the development.

## Record of tones sounds

Sounds of the tones of separate principal stops (plena stops) and sounds of the plena were recorded by MARC documentation method 8+1. This method among others uses configuration of three microphones, which are configured to the triangle and each of them is located in another high, see fig. 1. During the record these microphones trio were located on a telescopic tripod above position of standard listening up on high 1/2 of bay.



**Figure 1:** The configuration of the microphones trio at the acoustic documentation of the organ (method 8+1).

By means of this method (results averaging obtained from spectral analysis of three microphones) it is possible to reduce the influence of the standing wave and relatively independently of room acoustic to describe the acoustic properties of sound source.

Composition of 1st manual plenum stops: Octaaf 8', Octaaf 4', Octaaf 2', Ruispijp II st, Cimbél III st, Mixtuur VI st.

The record of the tones of the 1st manual plenum stops was made over night on the coming day to Zwolle at temperature 17,0°C and humidity 68%. The record of the plena tones themselves was made also over night, but two days after at temperature 18,5°C and humidity 65%. Tuning of organ was: A4 = 502Hz.

## Results interpretation

Owing to the possibility of the comparison of the spectral component levels and frequencies of the plenum stops tone sounds (obtained from spectral analysis) were grouped graphically and linked to the spectral components of the plenum tone sound, see fig. 2, 3. Thereby it is possible to make partly the comparison of the contributions of each partial spectral component (plenum stops) to the spectral components of the plenum as well as the comparison of the plena composition by various organ builders. In this contribution the results for the plenum of the 1st manual of the Schnitger's organ in St. Michaëlschurh in Zwolle in the Netherlands are presented. In figure 2 and 3 the results for tones C2 and C4 are displayed as example.

## Conclusion

From the results, see fig. 2, 3, we can see, that for example the 8th plenum harmonic of tone C2 is created the 8th harmonic of Octaaf 8', the 4th harmonic of Octaaf 4', the 2nd harmonic of Octaaf 2', the 3rd harmonic of Ruispijp II st and the 2nd harmonic of Mixtuur VI st, of which the 2nd harmonic of Octaaf 2' and the 3rd harmonic of Ruispijp II st have top level. Further it is evident, that the spectral components levels of the plenum stops tone sounds correspond to the spectral components levels of the plenum tone sound (considering that the phase situation are not known). Possible difference in levels can be caused:

1. By different pressure in a windchest at playing of plenum tones than at playing of one stop of plenum.
2. By different conditions of sound propagation in time of recording.

It is evident from the figures 2, 3, that builder of this organ designed the plenum of the 1st manual so, that e.g. the 1st harmonic of Cimbél III st stop applied as the 10th harmonic of plenum for tone C4 and the 40th harmonic for tone C2. The other relations are possible to be found (traced) also for the other plenum stops. On the basis of the comparison more instruments it is possible to find general rules (regularities, procedures) typical for organ family, for specific size of room or cultural epoch. It will be object of next research.

## Acknowledgements

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## References

- [1] Štěpánek, J, Otčenášek, Z & Syrový, V: Acoustic documentation of church organs. In proceedings of SMAC 93 (1993), 516-519

Results

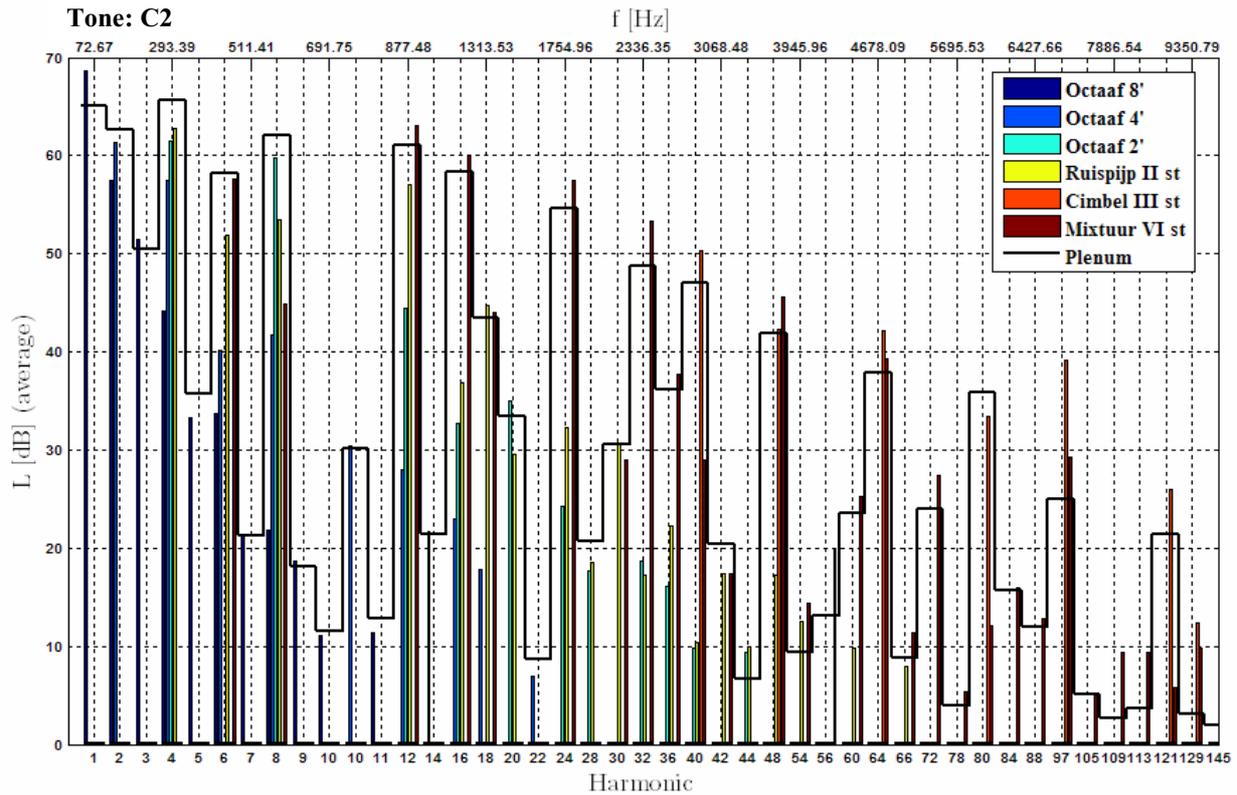


Figure 2: Spectral component levels of tone C2 sounds of plenum stops and plenum itself (plenum of 1st manual).

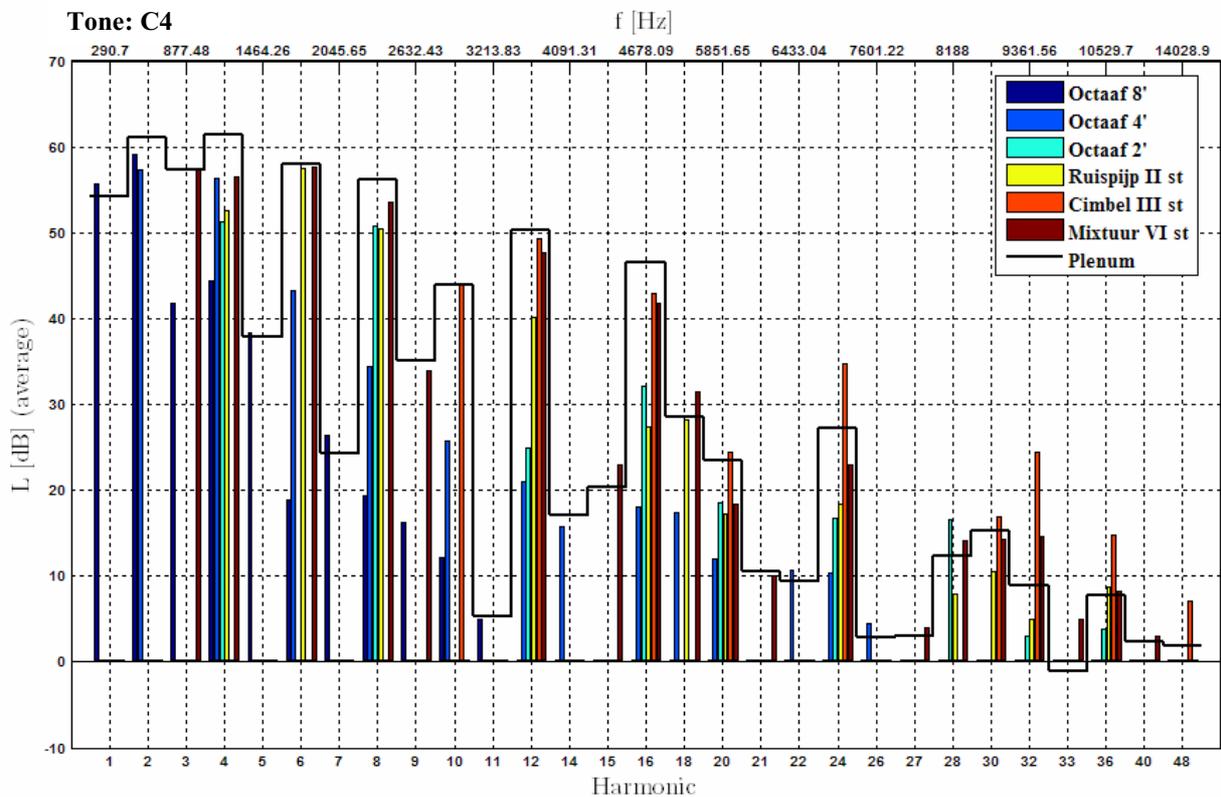


Figure 3: Spectral component levels of tone C4 sounds of plenum stops and plenum itself (plenum of 1st manual).