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Chorus Digitalis: polyphonic gestural singing

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Introduction

Chorus Digitalis is a choir of gesture controlled digital singers. It is based on: 1. *Cantor Digitalis,* a real time, gesture controlled singing voice synthesizer, and 2. the Méta-Mallette, an environment designed for collective electronic music and video performances. *Cantor Digitalis* is an improved formant synthesizer, using the RT-CALM voice source model. *Chorus Digitalis* is the result of the integration of voice synthesis in the Méta-Mallette environment. Each virtual voice is controlled by both a graphic tablet and a joystick. Polyphonic singing performances of *Chorus Digitalis* with four players will be given at the conference. The Méta-Mallette and Cantor Digitalis are implemented using Max/MSP.

Cantor Digitalis

Cantor Digitalis

- The synthesizer is based on a source filter model.
- Speaker's characterization: → **3 pitch ranges** with their respective source mechanism
  → **11 speakers** differentiated by:
  - The formant filters values
  - Tenseness (related to source parameters open quotient and asymmetry coefficient)
  - Breathiness (modulated pink noise)

Source: RT-CALM Model

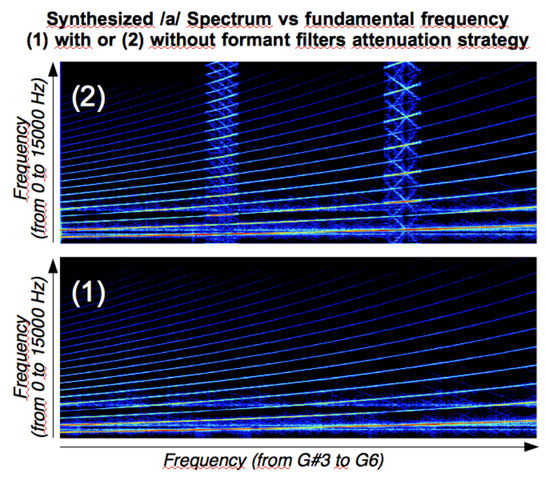
- **Real-time version of CALM source model** of the glottic air flow wave [1].
- **Solutions for extreme pitch values discontinuity**:
  - → High sampling rate : $8 \times 44100\,Hz$
  - → To avoid aliasing due to oversampling, use of a spline transition band filter with 20 coefficients, from the filter design tools by Vaasko & Välimäki in Matlab.
- **Voice Range Profile** adapted from previous works [2]:
  - → The mechanism is fixed for each pitch range to avoid the mechanisms shift discontinuity.
  - → Spectral tilt slope smoothing prevents big sound level difference between low and high pitch of a same register, to allow larger pitch range than with natural voice.

Filter: 4 parallel resonant filters

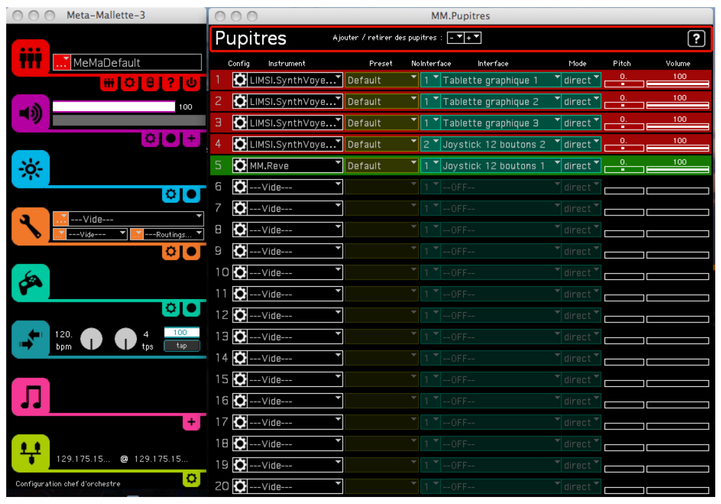
- 3 parameters for each formant filter :
  → Gain, central frequency and bandwidth

Source Filter interaction

- **Formant amplitude attenuation strategy**:
  → Decreasing of the formant filters gains when their central frequency coincides with F_0 or one of its 6 first harmonics (see figure).



Chorus Digitalis



Screenshot of Méta-Mallette 3.4 software

- **The Méta-Mallette** (© Puce-Muse) [3]:
  → Enables to play multiple virtual instruments in orchestra with a single or several interconnected computers.
  → Each instrument has a dedicated number of Audio & video I/Os that can be linked each one another.
  → Ability to easily change control interfaces and mappings.
- **Use of the Méta-Mallette to play a virtual choir: the *Chorus Digitalis***
  → Each of the chorus musicians controls one voice synthesizer.
  → Interfaces for each musician:
  - Graphic tablet (pitch, vocal effort, register)
  - Joystick (vowel, speaker)
- **Others control mappings available** directly in the Méta-Mallette:
  → Voice quality, diphonic singing.

Polyphonic Singing

The Chorus Digitalis quartet

- The *Chorus Digitalis* quartet, composed of 4 musicians, 4 graphic tablets and 4 joysticks, has been recently formed.
- The choir is able to play polyphonic choral music (e.g. Bach chorals or Renaissance polyphonic music), with a limited amount of training.
- We are currently exploring the possibilities of the choir in various types of musical styles.
- Extension of the choir to more voices is planed.

A graphic tablet used to control pitch and vocal effort.

Conclusion

- A digital choir has been developped in Méta-Mallette environment, and will be distributed in the Méta-Mallette library.
- Perspective: perceptual and performance experiments are planed, e.g. F0 accuracy measurements while mimicking a given natural voice, learning to play the instrument for subjects with different musical backgrounds.

References

- [1] B. Doval, C. d'Alessandro, N. Henrich (2003). « *The voice source as a causal/anticausal linear filter* ». In ISCA, editor, Proceedings of Voqual'03, Voice Quality : Functions, analysis and synthesis, Geneva, Switzerland.
- [2] S. Le Beux, "*Contrôle gestuel de la prosodie et de la qualité vocale*", Thèse de doctorat de l'Université Paris-Sud XI Orsay, France, Décembre 2009.
- [3] S. De Laubier, V. Goudard. "*Puce Muse - La Méta-Mallette*," Journée d'Informatique Musicale, 2008.