1. Introduction
The **decomposition of audio signals** into perceptually meaningful modulation components is highly desirable for e.g. efficient audio compression algorithms and new musical audio effects.

- **Decomposition** into sets of carriers, amplitude modulation (AM) and frequency modulation (FM) components
- Ill-defined problem, infinity number of possible solutions - thus need for **border conditions**
  - Adaption to human perception
  - Interpretability of modulation parameters
  - Scalability of audio texture detail
  - Minimal side artifacts for all types of modulation processing
  - Lowest possible processing delay

2. Proposed System
- **Analysis**
  - BP: carrier frequency estimation
  - AM: OLA (overlap-add)
  - FM: OLA (overlap-add)

- **Synthesis**

3. Spectral Segmentation
- **Temporal blocks**
  - 340ms duration
  - 75% overlap

- **Spectral Segments**
  - Seamless spectral coverage
  - Adaptive vs. critical bands
  - Local centre of gravity (cog)
  - Post-selection

4. Modulation Processing
- **Modification of AM/FM**
  - Roughness control

- **Modification of carrier**
  - Pitch Transposition
  - Local vertical coherence is preserved in AM (“envelope”)

5. Key Mode Change
- **Change of the key mode of polyphonic music content**
  - Carrier modification via MIDI pitch mapping
  - Circle of Fifth
    - Major to minor: 3 steps counterclockwise
    - minor to Major: 3 steps clockwise
  - FM is adapted to new carrier frequency value
  - Note onset detection not needed since ADSR info is contained in AM (“envelope”)

6. Listening Test Results
- **MUSHRA methodology**
- Six experienced listeners
- Tonal items

7. Conclusion
- A promising novel method for audio decomposition into modulation components
- High quality synthesis
- Scalable modulation detail
- Link between waveform and parametric coding
- Applications scenarios
  - Audio codec bandwidth extension
  - Research tool for auditory perception
  - New audio effects