# Introduction to **Audio Content Analysis**

## Module 3.3.4: Time-Frequency Representations — Filterbanks

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# introduction
## overview



### corresponding textbook section

section 3.3.4

- **lecture content**
  - gammatone filterbank
  - resonance filterbank

- **learning objectives**
  - explaining the principles of (auditory) filterbanks

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# auditory filterbanks
## introduction



FT and related transforms are bad models of physiological properties of the human ear:

- frequency resolution (critical bands)
- frequency scale (pitch resolution)
- loudness & masking
- event perception & time integration

$\Rightarrow$ **auditory filterbanks**

not as widely used as one might think because

1. computationally inefficient
2. analysis only: no invertibility (mostly)
3. not proven to be superior

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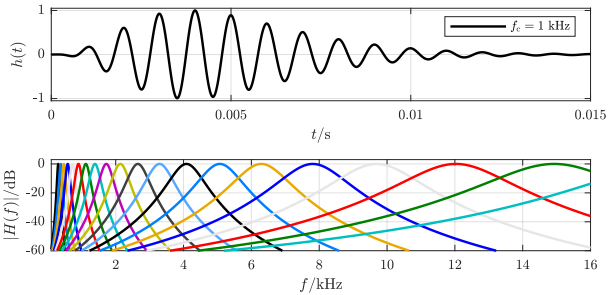
# auditory filterbanks
## gammatone filterbank

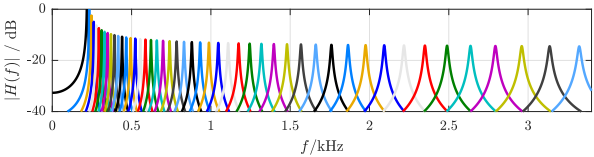


$$h(i) = \frac{a \cdot \left(i/f_S\right)^{\mathcal{O}-1} \cdot \cos\left(2\pi \cdot f_c \frac{i}{f_S}\right)}{e^{2\pi i \Delta f / f_S}}$$




matlab source: plotGammatone.m

# other filterbanks
## resonance filterbank




matlab source: plotResonanceFilterbank.m

# summary
## lecture content



- **filterbank-based frequency transforms**
  - possibly good model of human physiology
  - high time resolution
  - not invertible and inefficient
  - not proven to be superior