Real-Time Polyphonic Pitch Detection on Acoustic Musical Signals

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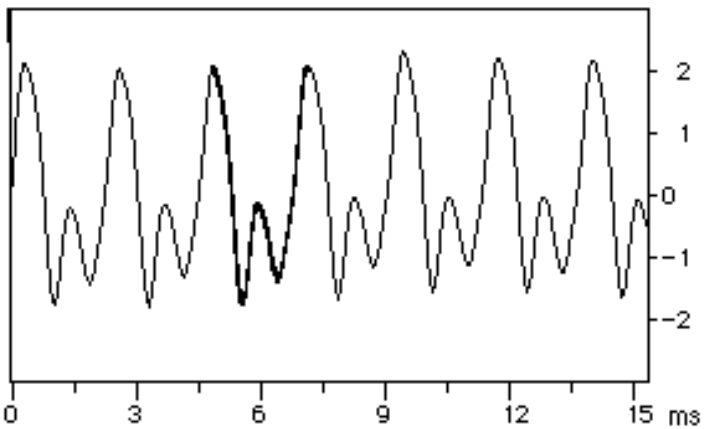
Aim

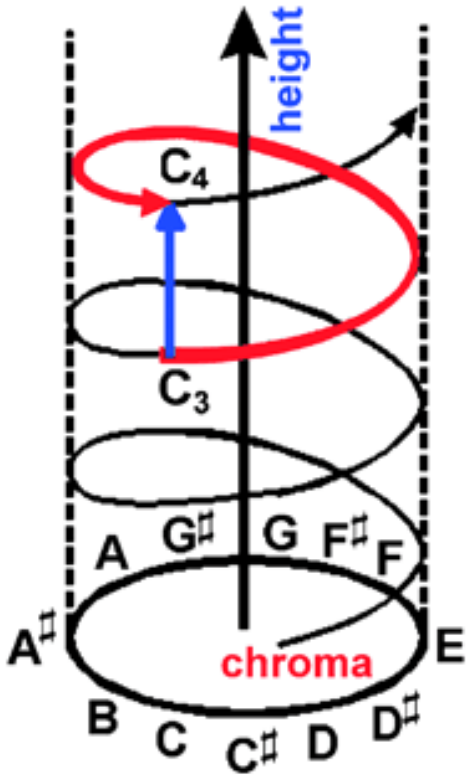
Take in an acoustic musical signal, and output the notes present.

Aim

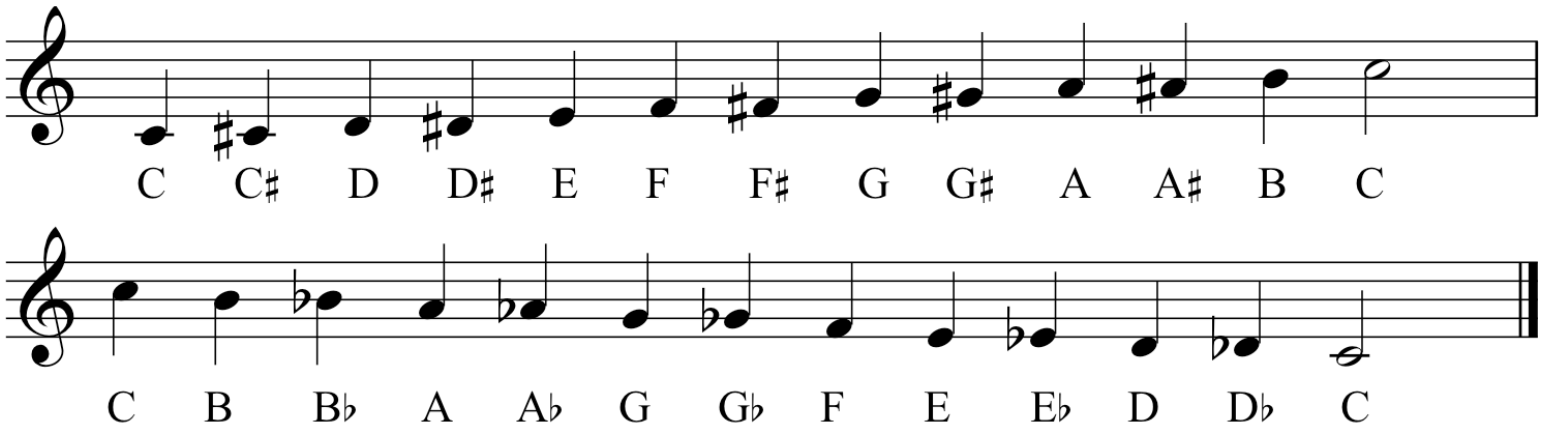


A4

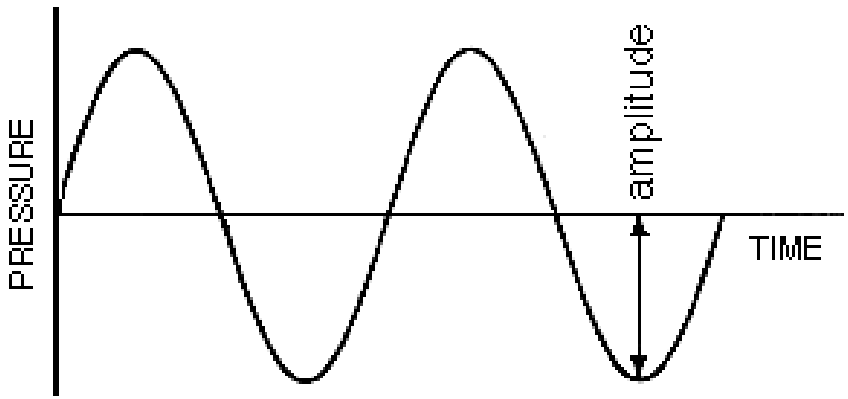
Categorising Notes



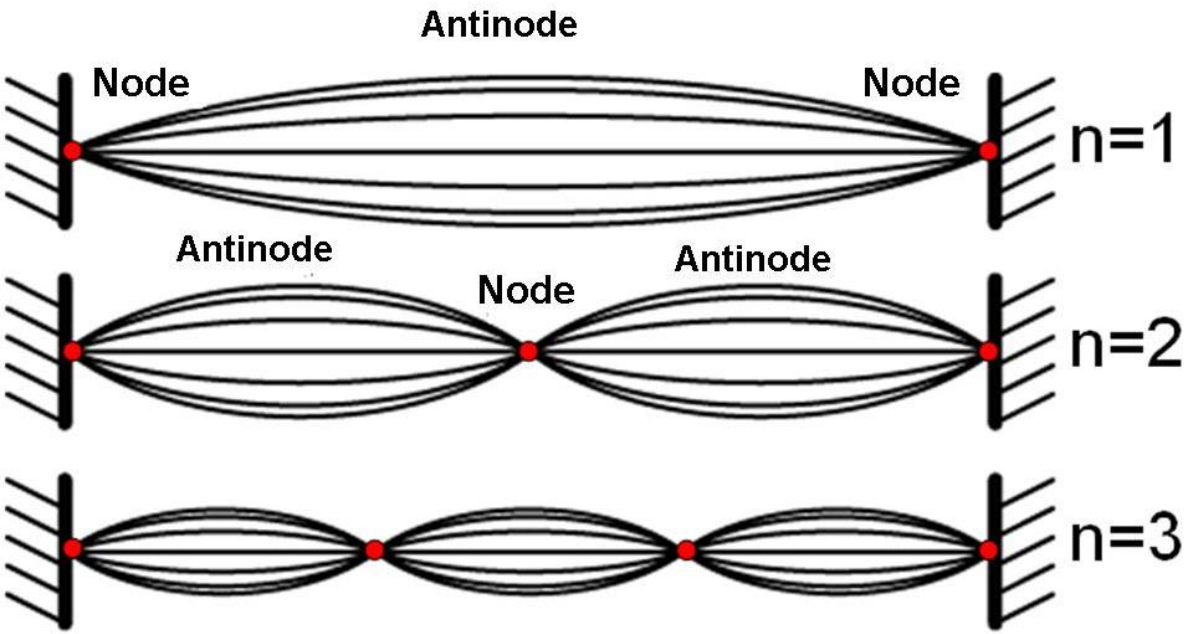
Categorising Notes



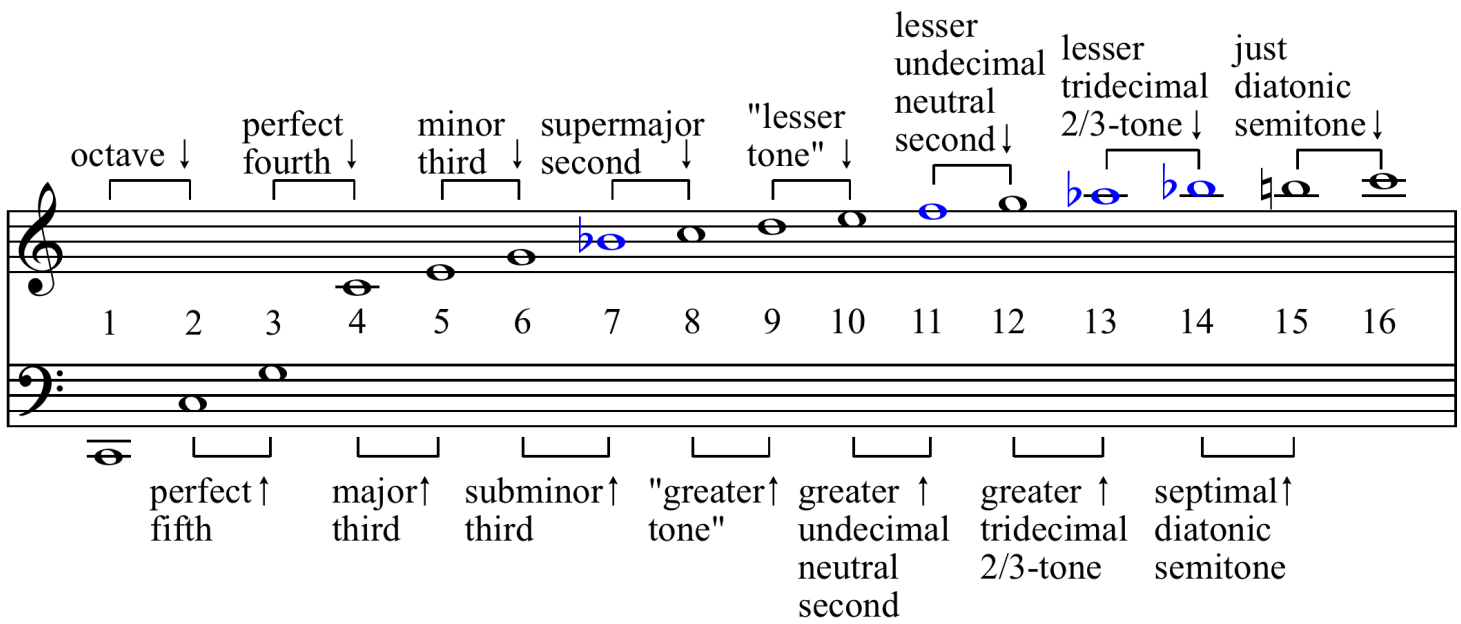
Musical Notes



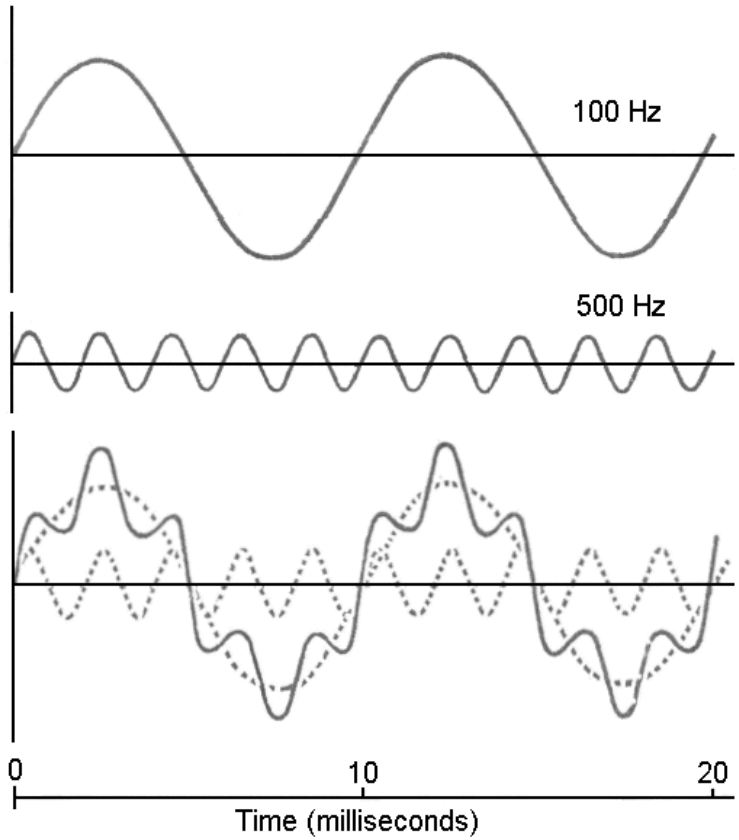
Standing Waves



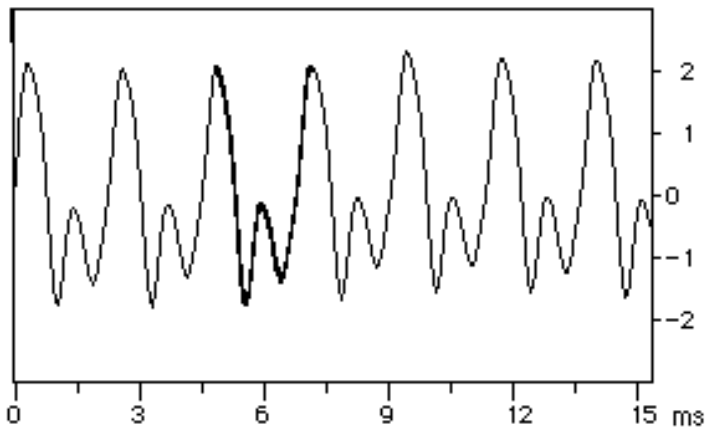
Harmonics

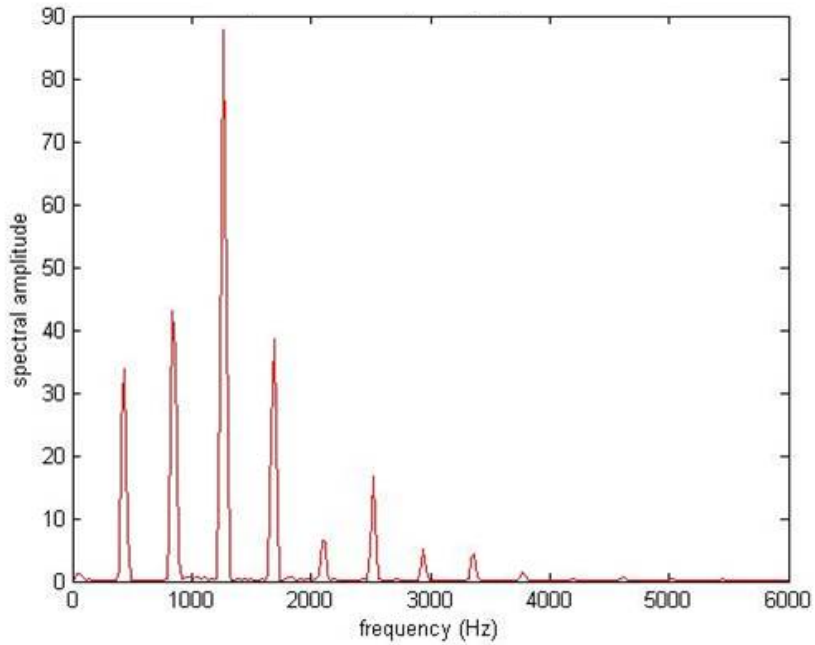

octave ↓
perfect fourth ↓
minor third ↓
supermajor second ↓
"lesser tone" ↓
lesser undecimal neutral second ↓
lesser tridecimal 2/3-tone ↓
just diatonic semitone ↓
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
perfect ↑ fifth
major ↑ third
subminor ↑ third
"greater ↑ tone"
greater ↑ undecimal neutral second
greater ↑ tridecimal 2/3-tone
septimal ↑ diatonic semitone

Implications

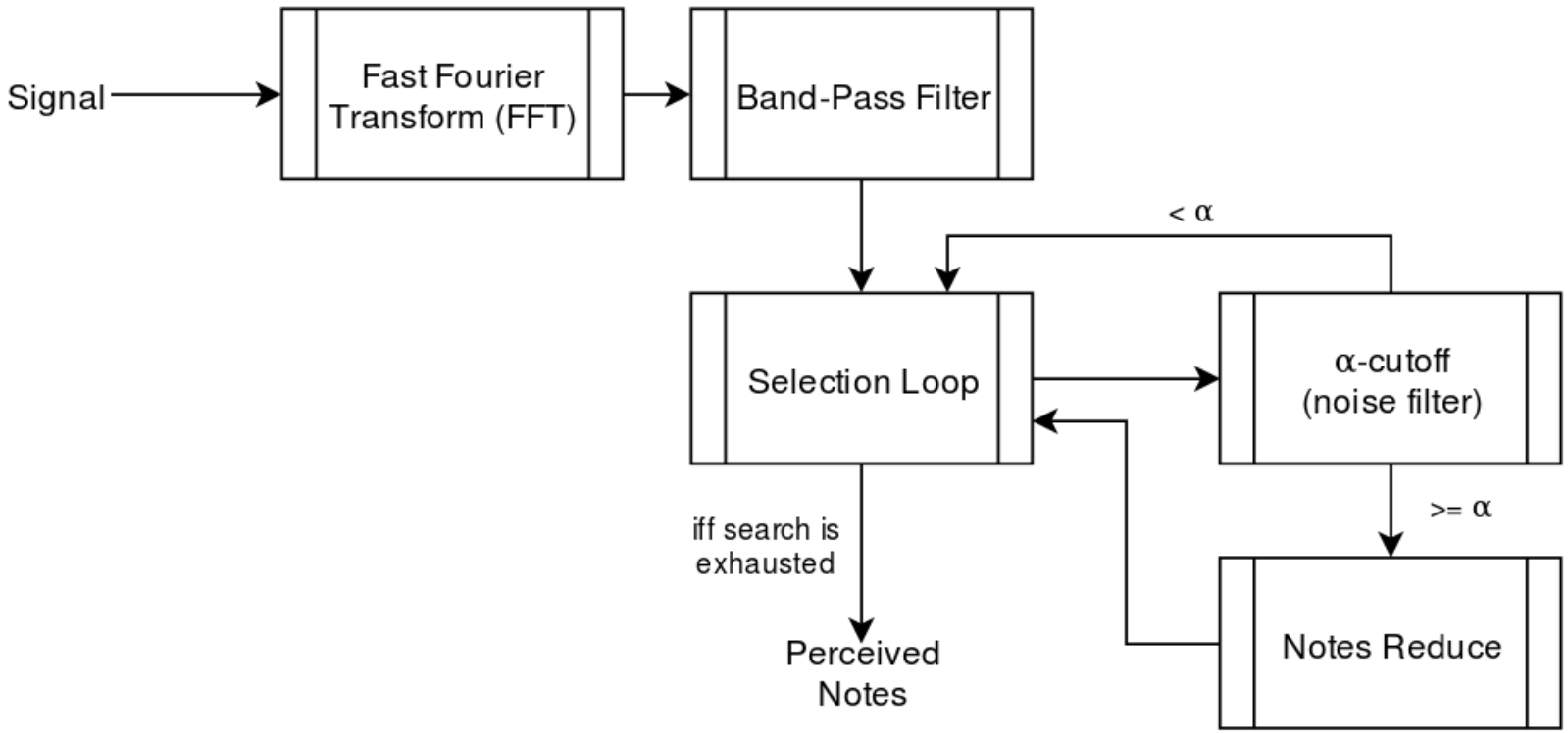


The Fourier Transform



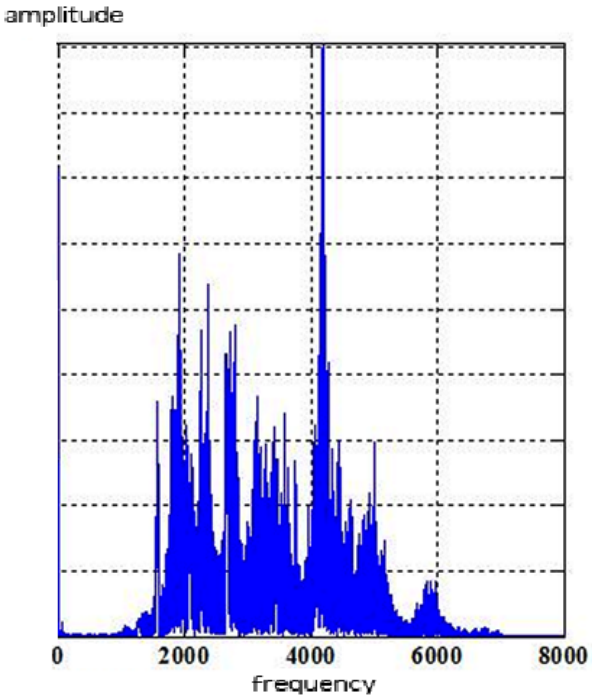


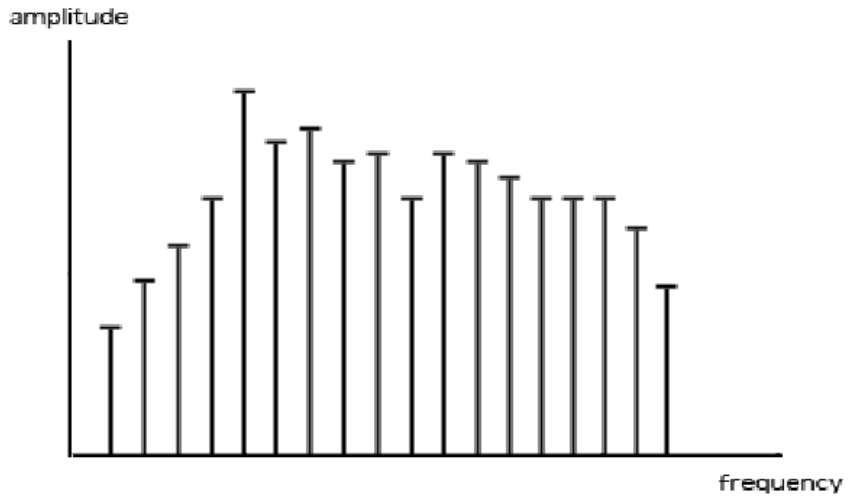
Overview


Signal
Fast Fourier Transform (FFT)
Band-Pass Filter
< α
Selection Loop
α-cutoff (noise filter)
iff search is exhausted
>= α
Perceived Notes
Notes Reduce

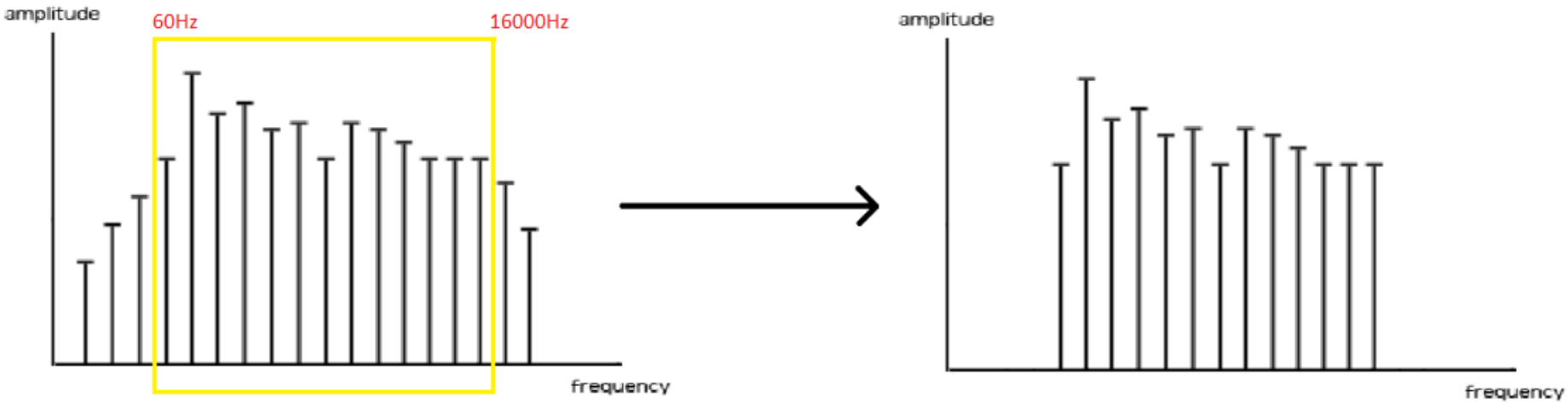
Assumption - No Undertones

Clustering

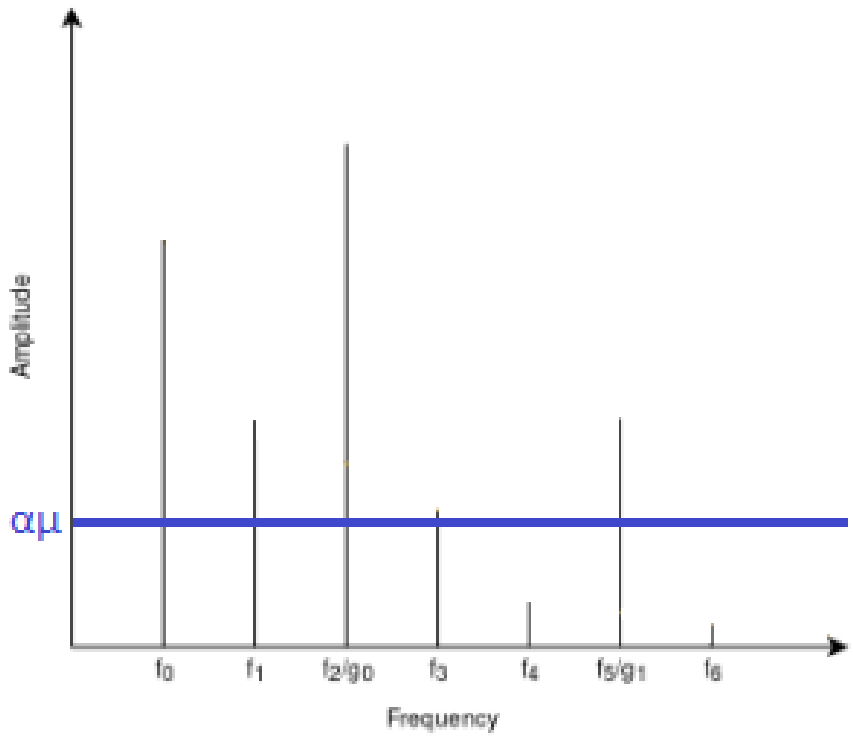

amplitude
0
2000
4000
6000
8000
frequency


amplitude
frequency

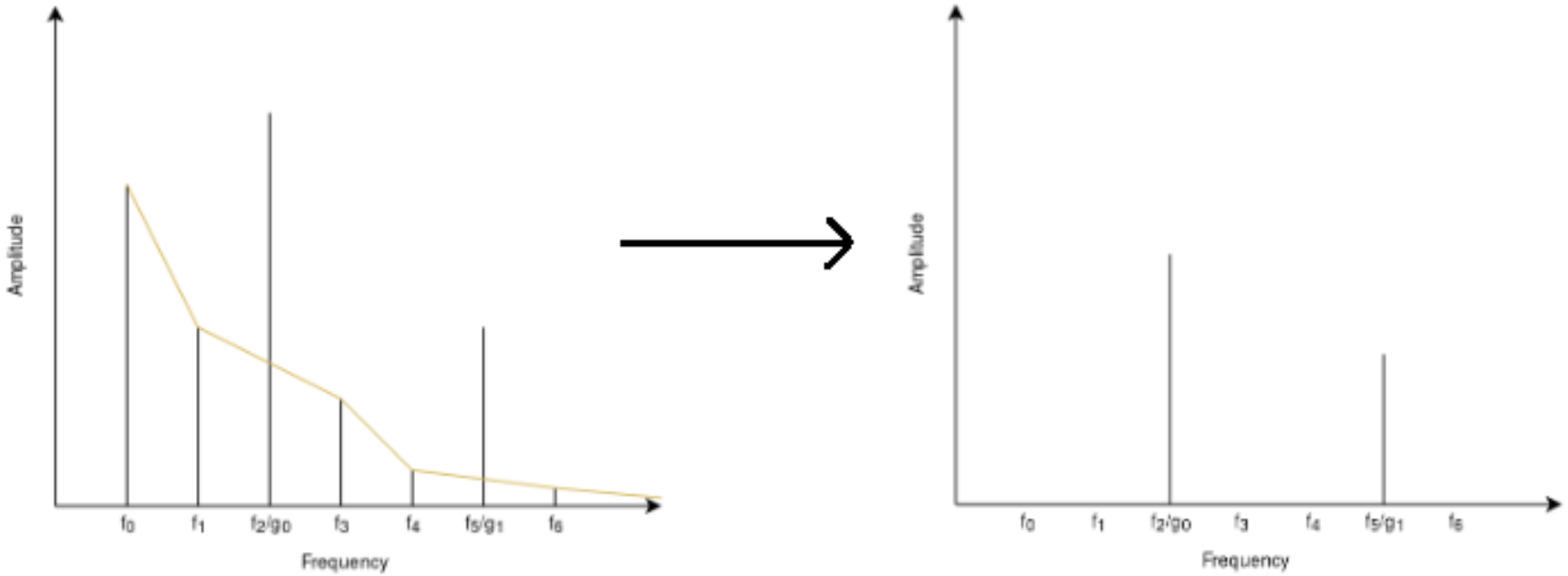
"Band-Pass" Filter



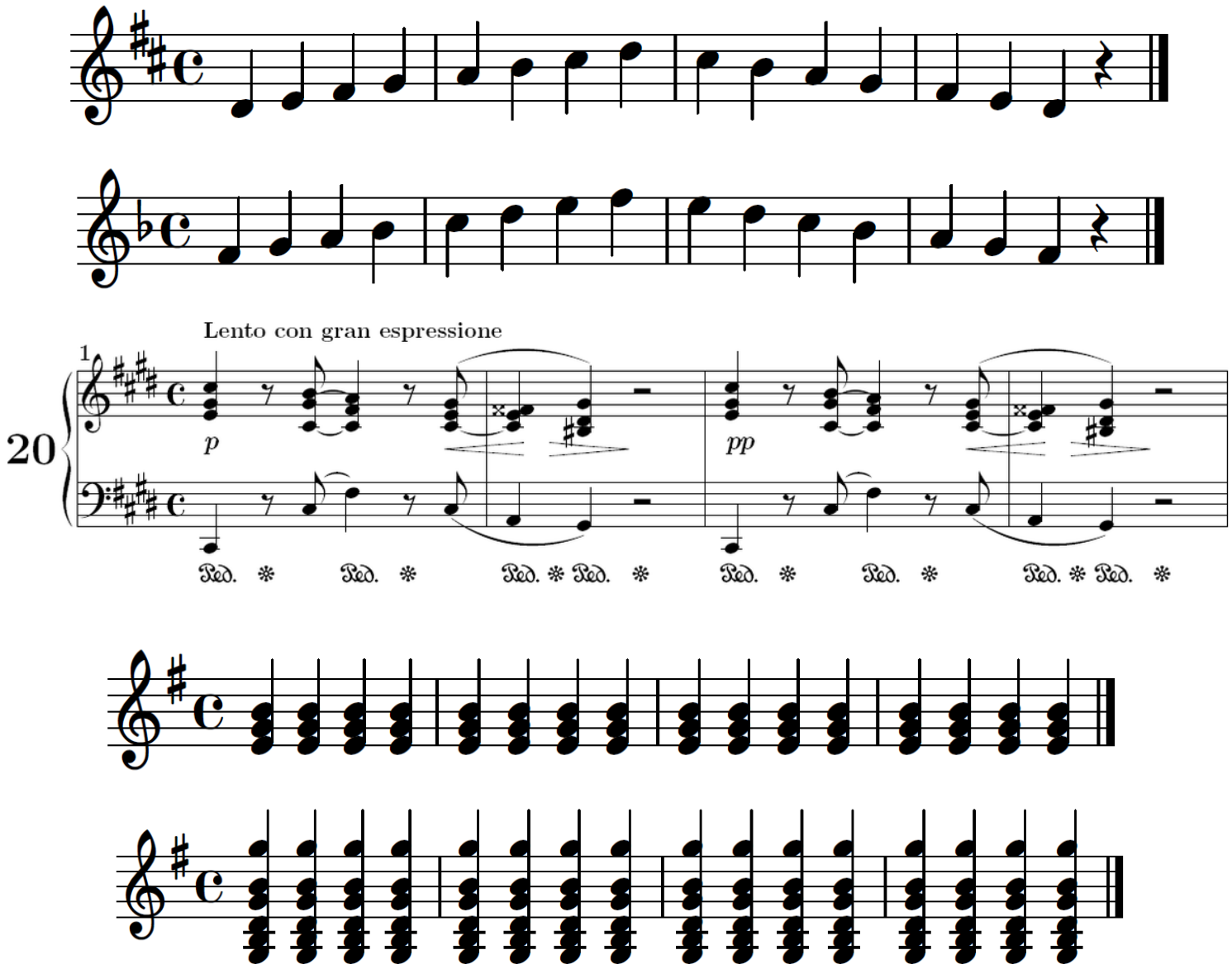
Selection Loop & α-cutoff



Notes Reduce



Testing



Results

	Precision	**Recall**	**Specificity**	**Accuracy**	**F-Score**
Test 1	78.09%	93.89%	83.00%	86.89%	84.78%
Test 2	100.00%	97.22%	100.00%	97.85%	98.55%
Test 3	82.46%	75.67%	77.52%	76.36%	78.85%
Test 4	86.31%	82.50%	53.33%	75.83%	83.47%
Test 5	65.08%	100.00%	64.29%	79.07%	78.47%
μ	82.39%	89.86%	75.63%	83.20%	84.82%

Improvements & Future Work

- Adapt evaluation to use a larger & more widely-adopted dataset (eg. MAPS)
- Adapt 'Notes Reduce' to model harmonics on an instrument-to-instrument basis
- Apply source separation to reduce polyphonic problems to multiple monophonic problems

Conclusion

- Outlined an effective method for pitch detection, in real time, on both monophonic & polyphonic signals
- Number of clear downsides to the current approach, but these can be improved upon through future research
- Solid basis for more investigation into the area

Questions?

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Slides at http://tomg.io/isspit-1-slides.pdf

Please get in touch with any questions!