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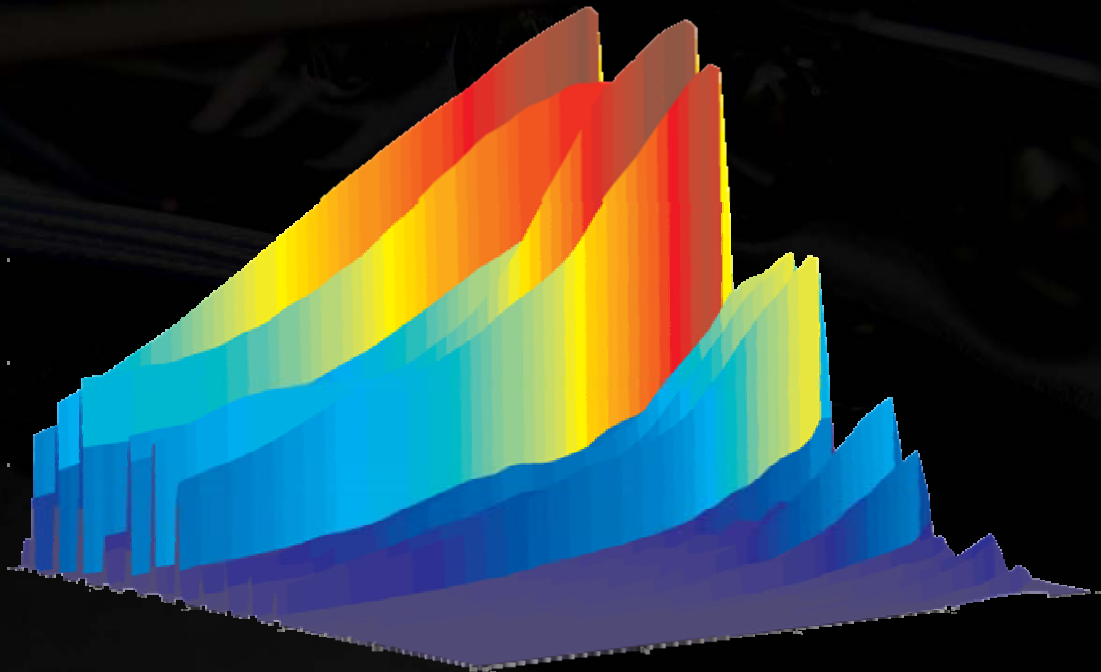
Octophonic Guitar Pickup

Eli Gibson

Kamil Kisiel

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Introduction



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Outline

- The Need
- Hydra: The Solution
- Applications
- 4 C's: Connectivity, Control, Creativity, Cost
- Development Process
- Scheduling Report
- Budget Report
- Demonstration

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The Need

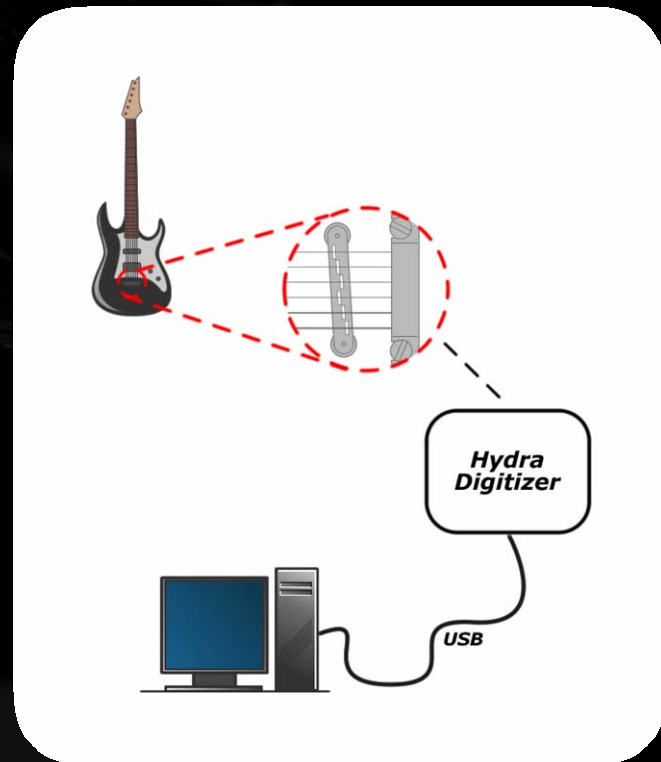
- Keyboardists had greatest freedom
- Keyboard playing easier to detect
- Guitar is more expressive
- Each string recorded individually
- Existing systems expensive, complicated, and limiting

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Hydra: The Solution

- Maximum flexibility
- High quality sound
- Compact
- Easy to use
- Low cost



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Applications

- Home recording
- Sound synthesis
- Advanced effects
- Acoustic modelling
- Transcription
- Instruction

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Connectivity

Control

The 4 C's

Creativity

Cost

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Connectivity

- USB 2.0 High Speed
- Simplicity
- No additional hardware
- Compatibility

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Control

- Octophonic output
 - 2 channels for magnetic pickups
 - 6 piezoelectric pickups measure vibrations
- Professional audio quality (24-bit, 96kHz)
- Early digitization

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Creativity

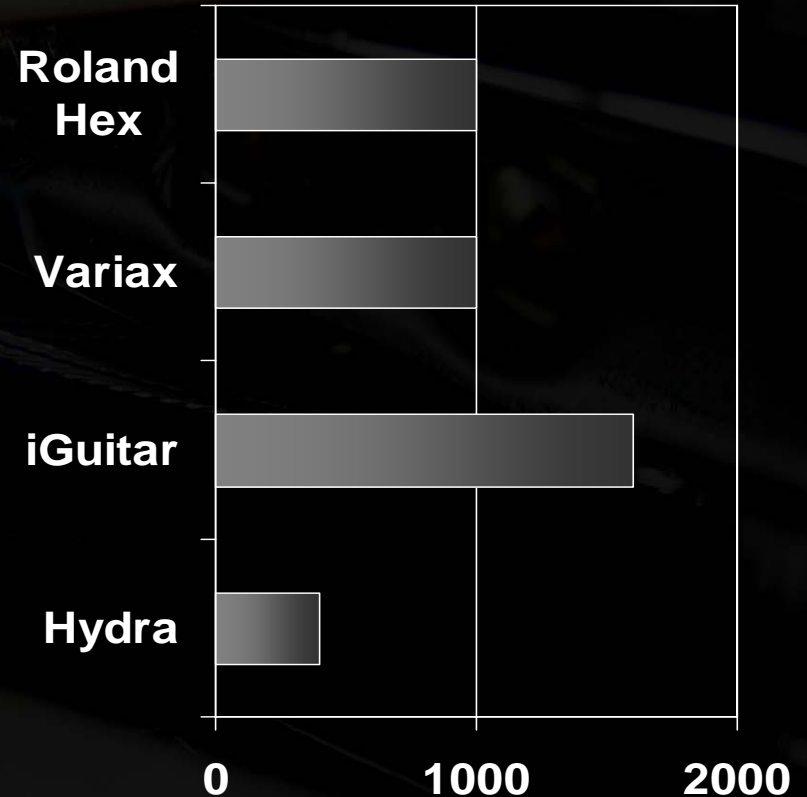
- Non-linear processing
- Acoustic modelling
- Selective transformation
- Real-time pitch detection

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Cost Advantages

- No additional hardware required
- Uses any guitar body
- All forms of processing done on one PC



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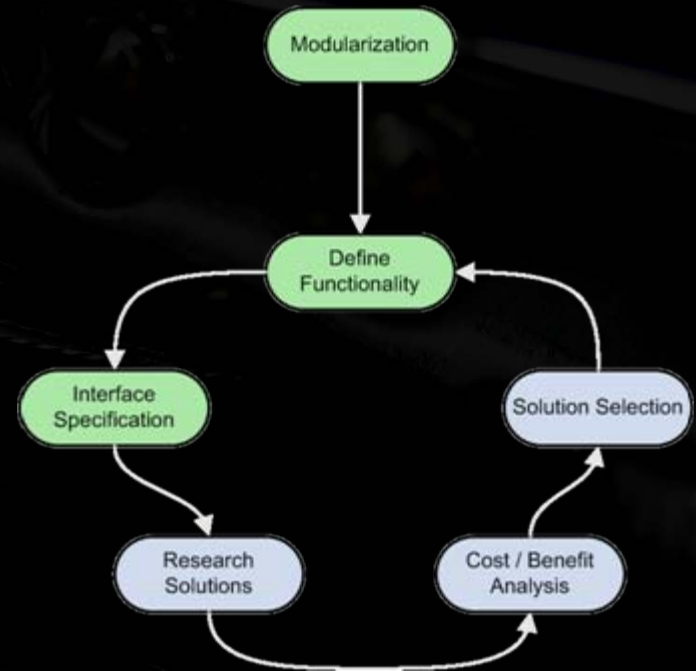
Design Process

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Design Process

- Requirements gathering
- Functional Specification
- Modularization
- Iterative Design
 - Design Specification
 - Implementation



Design Constraints

- Professional level audio
- Octophonic output
- Latency
- Ease of use
- Size
- Power
- Cost

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Design Considerations

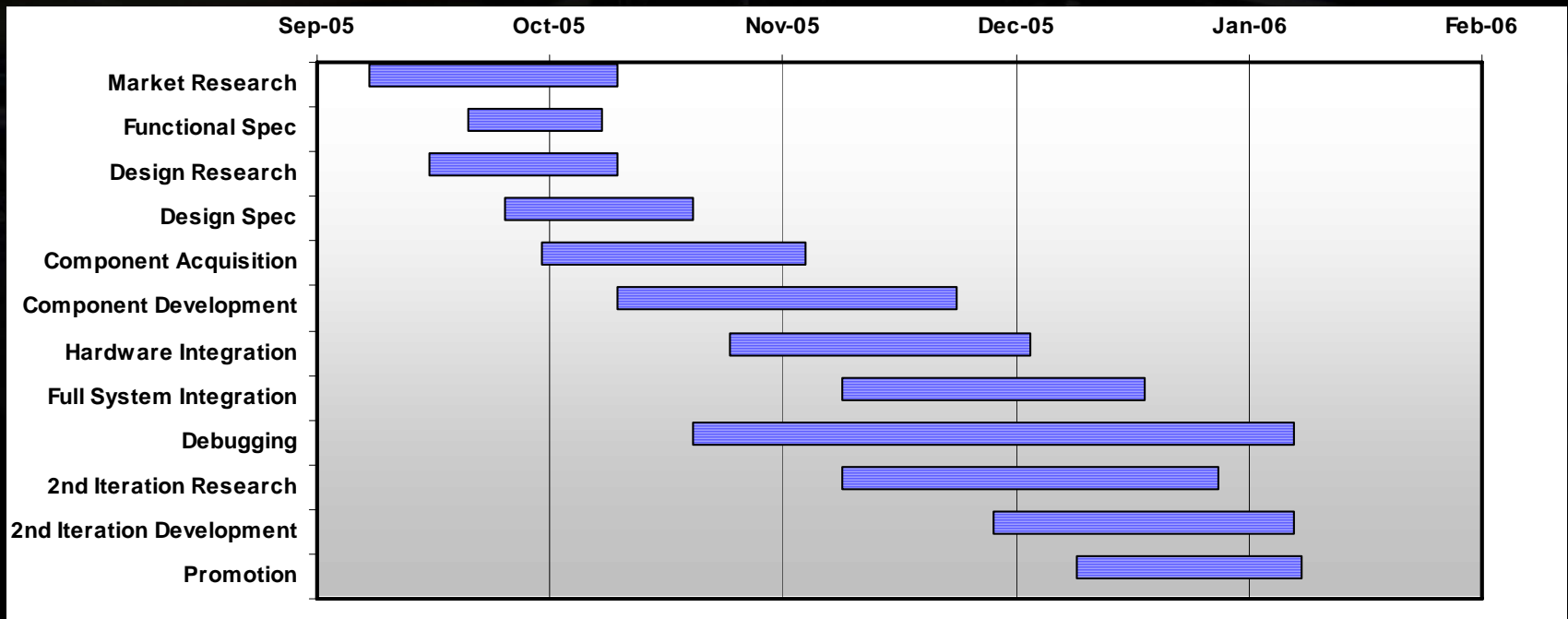
- Piezoelectric transducers
- Analog to digital converters
- Power supply
- PC interface (USB 2.0 High Speed)
- System on Chip (SoC)

Development Reports

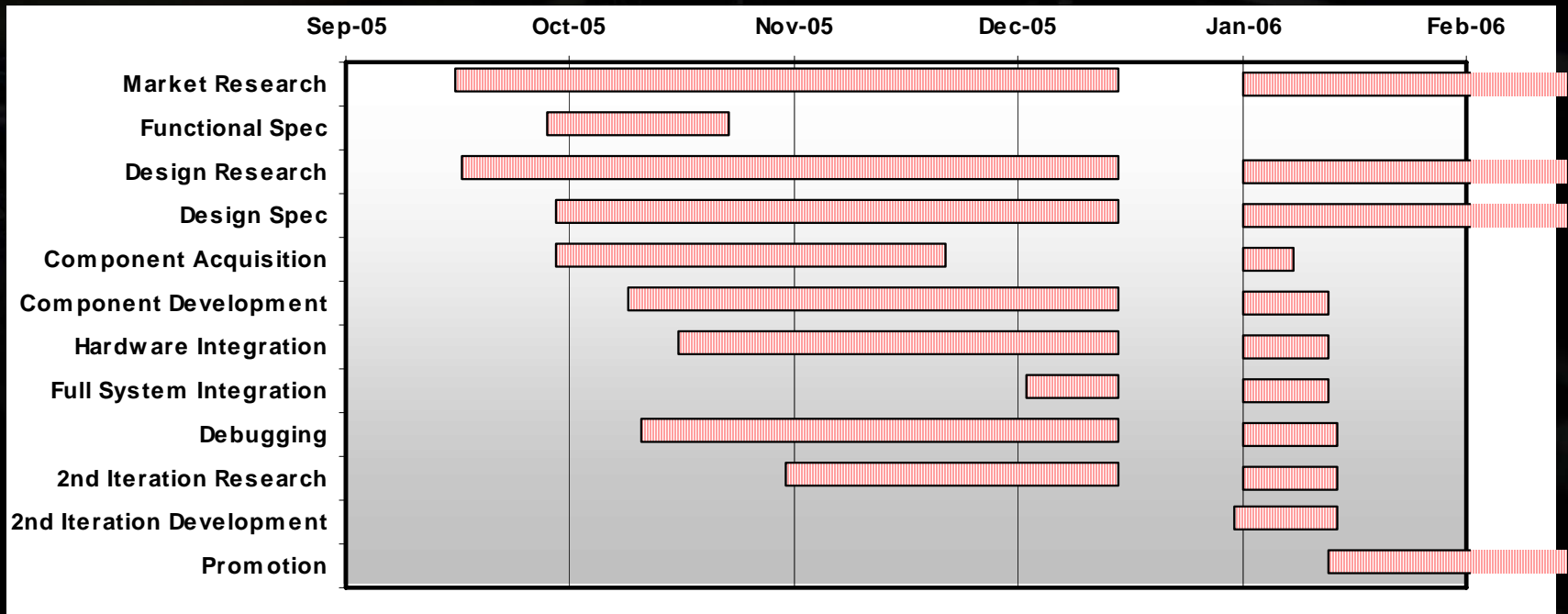
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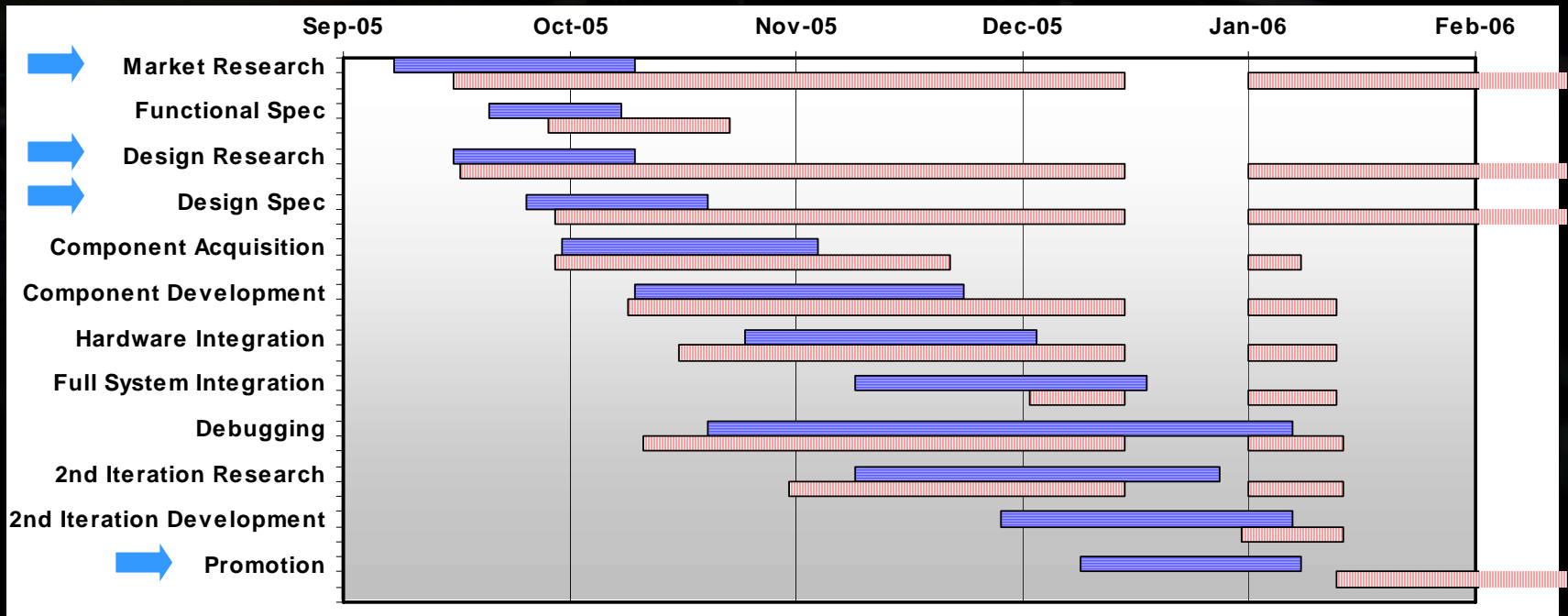
Scheduling Report



Scheduling Report



Scheduling Report



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Scheduling Report Summary

- Iterative design
- Ongoing market research
- Ongoing development
- Ongoing promotion
- Hit critical marketing deadline

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Budget Report

Item	Budgeted	Cost	Difference
Guitar Pickups	\$195	\$485	-\$ 290
Guitar	\$150	\$150	+\$ 0
Prototyping	\$310	\$845	-\$ 535
Signal Electronics	\$60	\$63	-\$ 3
Soldering Equip	\$0	\$140	-\$ 140
PCB Fabrication	\$300	\$0	+\$ 300
Misc Electronics	\$65	\$63	+\$ 2
Net	\$1080	\$1746	-\$ 666

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Team Dynamics Issues

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Conclusion

- Digital Revolution - Digital Expression
- The Hydra
- Connectivity Control Creativity Cost
- Metrics for Success

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Questions

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Demonstration

- Pitch detection
- MIDI control
 - Speed
 - Polyphonics
 - Pitch bending
 - transcription

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Questions

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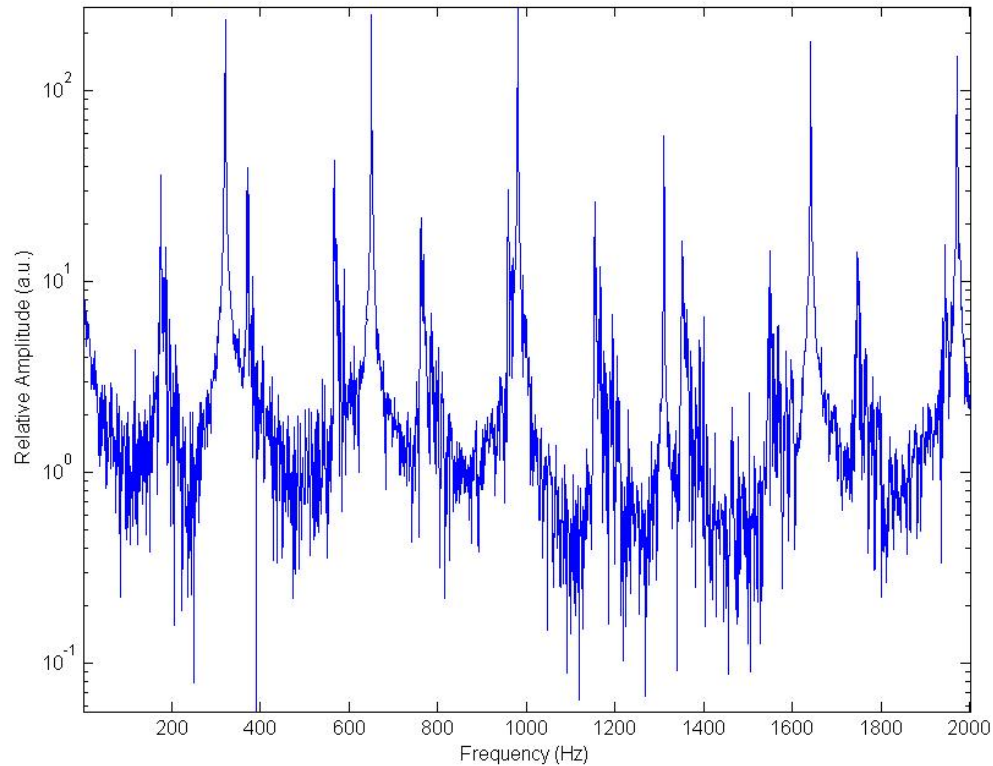
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Technical Slides

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SNR Calculation



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YIN

Steps:

1. Autocorrelation function
2. Difference
3. Cumulative Mean Normalized Difference
4. Absolute Thresholding
5. Parabolic Interpolation
6. Best Local Estimate

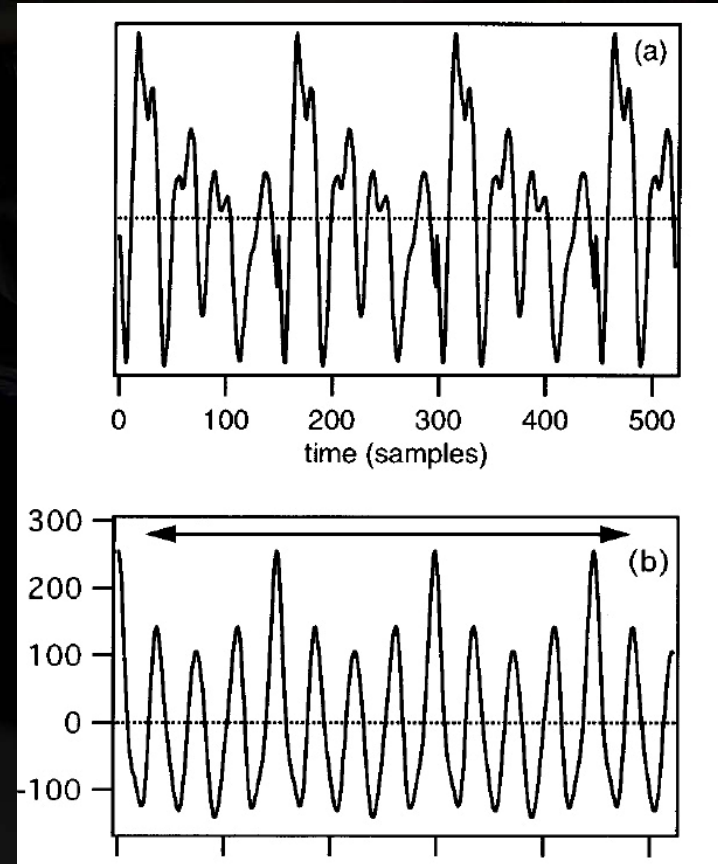
YIN 2

Our additions to the algorithm

1. Statistical analysis of error rates
2. Development of confidence measures
3. Implementation of heuristics for stable output

YIN 3

Input Signal:



Autocorrelation Function:

From Cheveigne and
Kawahara 2002

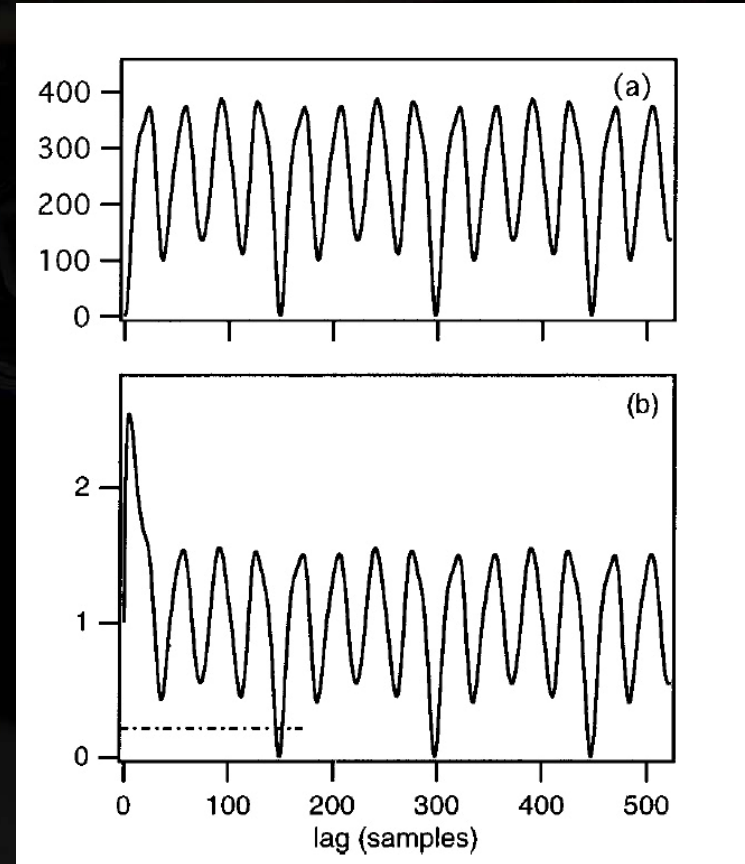
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YIN 4

Difference Function:

Cumulative Mean
Normalized Difference
Function:



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