Pitch Structure

Pitch Spelling

Chord Identification
Key Finding

Time Structure

Beat Tracking
Meter Induction

Segmentation
Style Recognition
Pattern Processing

Applications

Automated Transcription
Music Computer Analysis
Music Categorization and Retrieval
Expressive Performance

Components for machine models of musical intelligence.
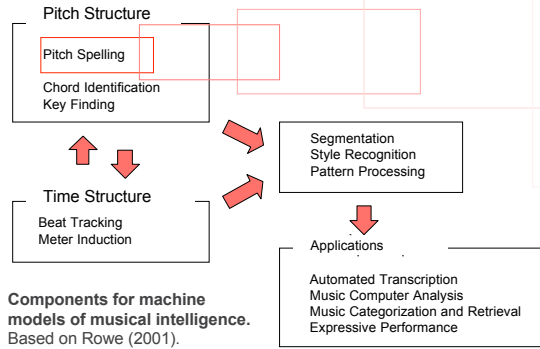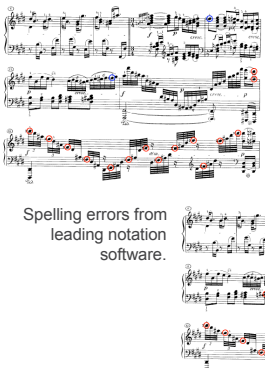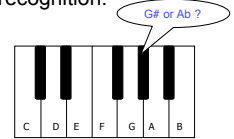Based on Rowe (2001).

Determining Context-Defining Windows
- pitch spelling using the spiral array

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Pitch spelling - a critical first step in automated transcription and algorithms for music analysis and recognition.
We present **three pitch spelling algorithms** based on the Spiral Array model.
The Spiral Array is a **spatial model for representing pitch relations** in the tonal system.
Our test set is Beethoven's Piano Sonata Op.79 and Op.109. **Overall success rate: 99.03%**.

G# or Ab ?

C D E F G A B

Spelling errors from leading notation software.

Segment to determine context

Assign pitch name

Algorithm 1: Cumulative CE

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The algorithm advances one chunk (beat) at a time.

Beethoven Op.79, 3rd movement: **1 error in 1375**.
Beethoven Op.109, 1st movement: **73 errors in 1516**.
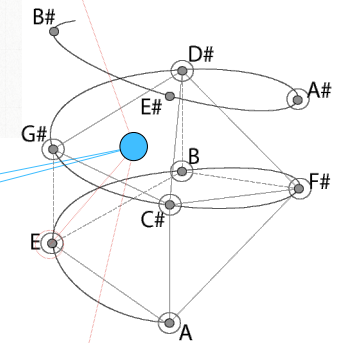
Algorithm 2: Sliding Window

Algorithm 2: Sliding Window
Uses local tonal context. Improves sensitivity to local changes, but not sudden ones.

Op.109: **31 errors in 1516**.

The Spiral Array
clusters closely-related pitches and summarizes musical information as spatial points in the interior of the structure.

B#
D#
A#
E#
G#
B
F#
C#
E
A

Results

Method	Parameters			Errors (1516 notes)	% Correct
Cumulative				73	95.18
Sliding Window (w)	4			31	98.00
	8			47	96.90
	16			40	97.36
Two-Phase (w, wr, f)	4	2	0.6	28	98.15
	4	3	0.8	**27**	98.22
	4	3	0.7	27	98.22
	8	2	0.9	31	97.96
	8	4	0.9	40	97.36
	8	6	0.9	**27**	98.22
	16	4	0.8	40	97.36
	16	6	0.8	**30**	98.02
	16	8	0.9	37	97.56

Algorithm 3:Two-phase assignment

Algorithm 3: Two-Phase Assignment
First step as in Algorithm 2. Second phase re-visits spellings using a combination c.e. from a smaller local window and long-term cumulative window. Algorithm is sensitive to abrupt key changes.

Op.109: **27 errors in 1516**

• Sliding window algorithm consistently better than cumulative method.
• The two-phase assignment method outperforms the sliding window algorithm.
• Algorithms 1 and 2 are special cases of Algorithm 3.

By combining both short-term and long-term tonal contexts, we get the lowest error rates in pitch spelling. Pitch spelling is a function of both local and global tonal contexts.

The Center of Effect:
a summary point used in assigning pitch spellings using nearest neighbor searches in the Spiral Array space.

Name Assignment:
using nearest-neighbor search