Modelling Celtic Violin Expressive Performance

MML 2008

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What is Expressive Music Performance?

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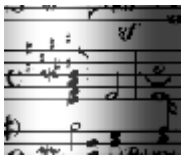

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In the Past

Expressive performance: important issue in musicology

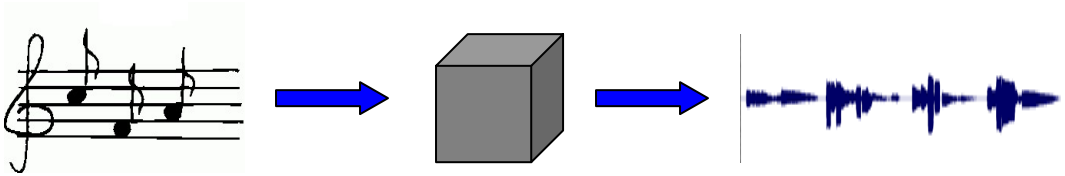
- Statistical analysis
- Mathematical modelling
- Analysis by synthesis

- In these approaches, person responsible for devising a theory.
- Theory tested on real performance data

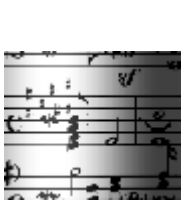
Here, we …

- Use ML to induce models to *Predict* local expressive transformations given a score note and its context
- *Two aims*
  - **Interpretative model**

    R23: ``At nominal tempo, **if** the duration of the next note is similar, and the note is in a strong metrical position and the note appear in a D Narmour group, **then** lengthen the note"
  - **Generative model**



Basic Research Framework



encode

obtain

Machine representation

High-quality recordings

extract

analyse

Symbolic description

Structure of pieces

Expressive aspects of recordings

MLearning

Models

Analyse

Expressive Music Performance in our Context

- Irish folk pieces
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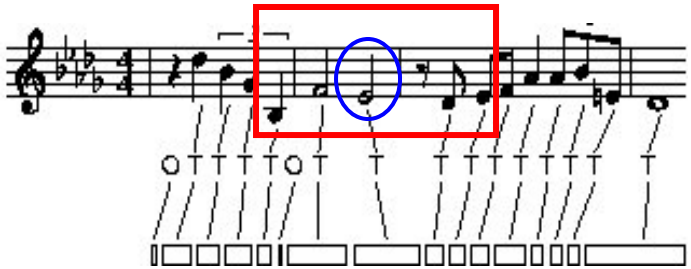

Expressive Music Performance in our Context

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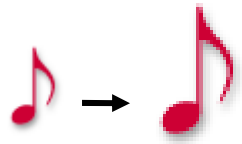
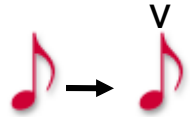
-  
-  
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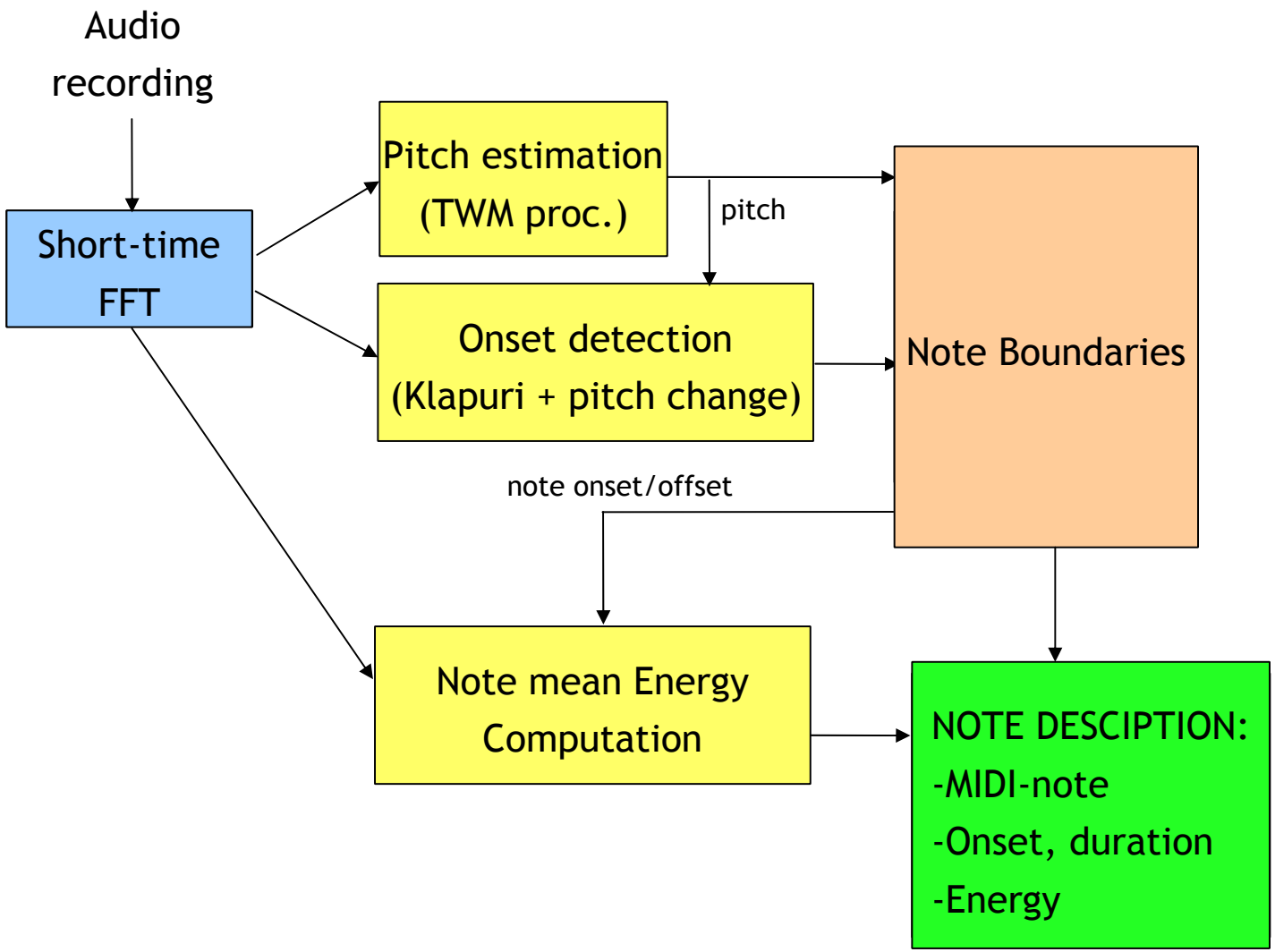
Modeling Expressive Music Performance

- Training data
  - Monophonic audio recordings
  - 9 Celtic pieces
  - 811 notes
  - Symbolic features are extracted from audio

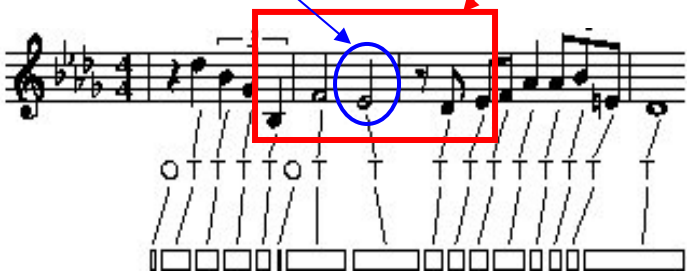
Audio Note Descriptors Extraction



Score Note Descriptors

Note descriptors
- Note duration
- Note Pitch
- Note Metrical Strength

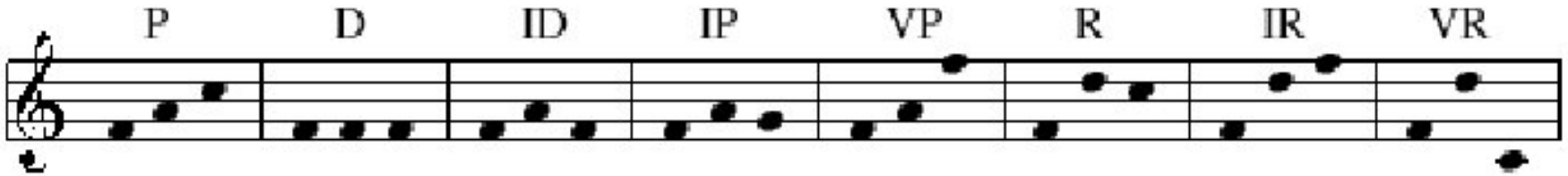
Local Context Descriptors
- Previous and next note relative duration
- Previous and next note relative pitch
- Variable window width

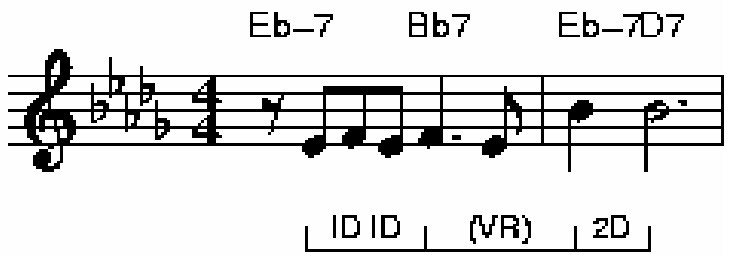


Structural Context Descriptor
- Note Narmour groups

Performance Tempo

Narmour Representation: Basic Melodic Units





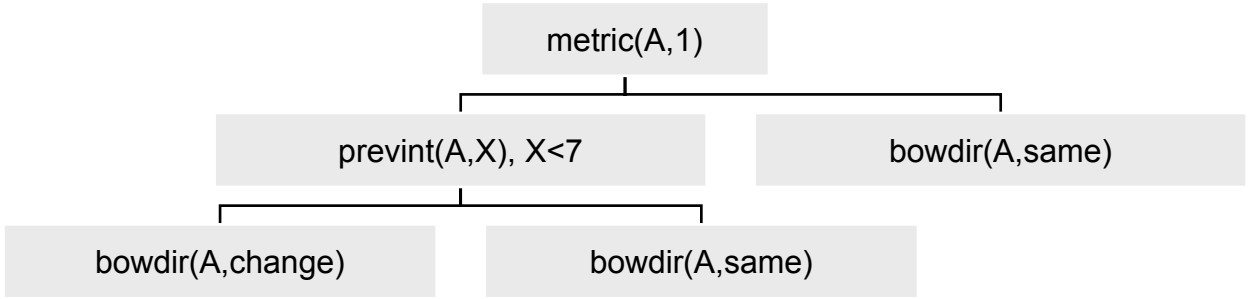
Learning Algorithm

We apply Tilde ILP system to induce FOL rules (i.e. rules with variables)

Tilde: may be seen as first order logic extension to C4.5

Instead of testing attribute values at the nodes, Tilde tests logic predicates

both for classification and regression



Background knowledge:

e.g. *succ(X,Y)* means Y is the successor of X

succ(X,Y) allows the specification of arbitrary-size context window by

$succ(X_1,X_2), \ldots, succ(X_{n-1},X_n)$ where X_i $(1 \leq i \leq n)$ is the note of interest

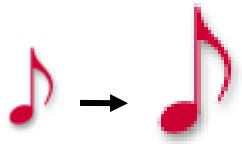
e.g.

```
duration(C, 1.4) :- succ(C, D), succ(D, E), succ(E, F), context(F, [nargroup(vp, 3)|G]).
```

`` *Lengthen a note **n** (by 40%) if note **n+3** belongs to a **VP** Narmour group in 3rd position"*

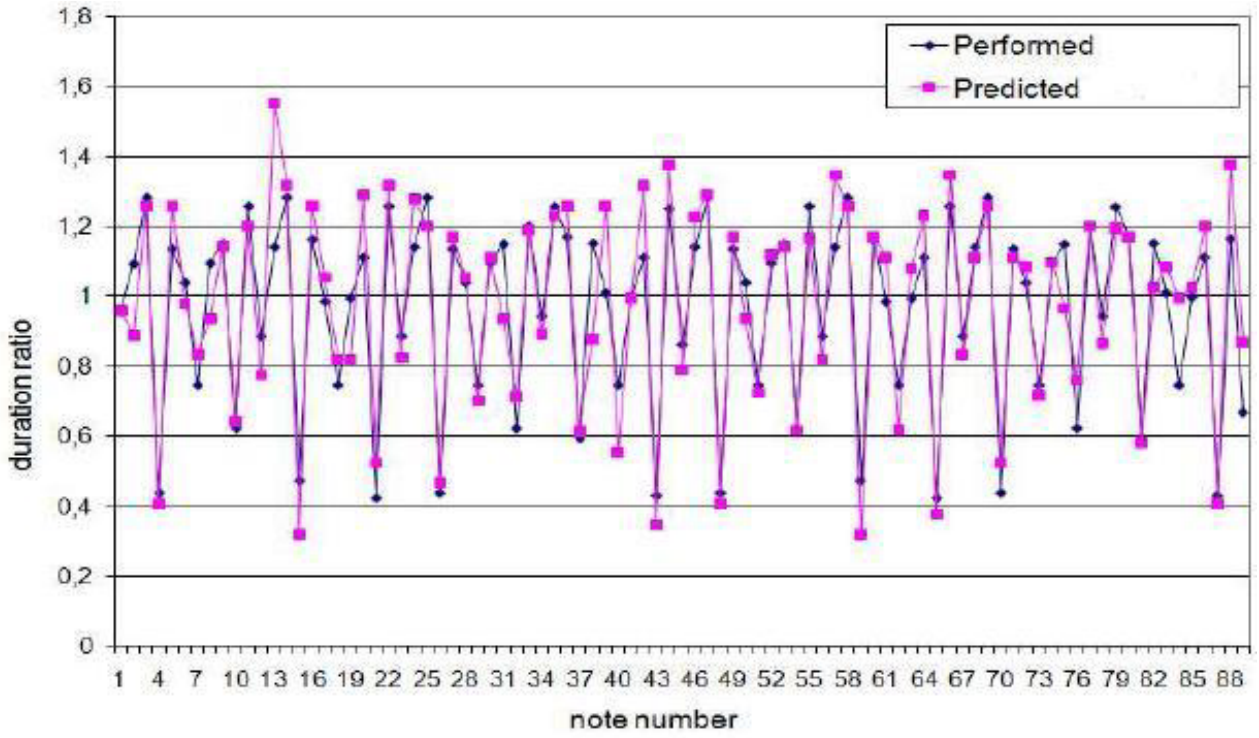
Target predicates

Target Predicates

-   duration(A,DurRatio)
-   energy(A,EnergyRatio)
-   bowdir(A,Class)
  Class = change, same
-  alteration(A,Class)
  Class = ornament, none

Results

- Correlation between model predicted duration values and the actual performed values for a piece not in the training set

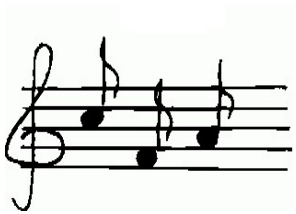


- Correlation coefficients: Duration =0.88, Energy = 0.83

  C.C.I.%: Alteration = 86%, Bow Direction = 94%

10-fold cross-validation

Synthesis



Model

Duration Model
Energy Model
BowDir Model
Ornament Model

Sinthesis Engine

ICMC'08

Some current and future work

- (violin) Performer identification (ISMIR'08)

- Moods in expressive music performance (SMC'08)

- Vibrato, more ornament types

- Analyse rules' meaning

- ML-based models for learning the structure of music

- Multi-player expressive performance modeling

- Expressive violin tutoring system