



# Introduction to **Audio Content Analysis**

module 15: music performance analysis

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# introduction

## overview

### corresponding textbook section

#### chapter 15

#### ■ lecture content

- musical communication
- music performance
- music performance analysis

#### ■ learning objectives

- give examples for score-inherent and performance-inherent musical characteristics
- describe typical challenges in music performance analysis



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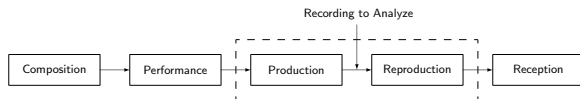
- give examples for score-inherent and performance-inherent musical characteristics
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# music performance

## introduction

- music exists only with performance
- performance realizes acoustic rendition of musical ideas
- each rendition is unique
- score information is interpreted, modified, added to, or dismissed
- adds “expressivity”



# music performance parameters

category	score representation/idea	performance
tempo/timing	explicitly defined rhythmic content	tempo, micro-timing
dynamics	basic dynamics instructions	accents,...
pitch	explicitely defined pitches	vibrato, intonation,...
timbre	implicit definitions (instruments, ..)	playing techniques

# music performance analysis

## goals

by analyzing the music performance, we learn about

### ■ the **performance**:

- general performance characteristics
- notable stylistic differences (over time, between artists, ...)

### ■ the **performer**:

- mapping of intent and projected emotion to measurable parameters

### ■ the **listener**:

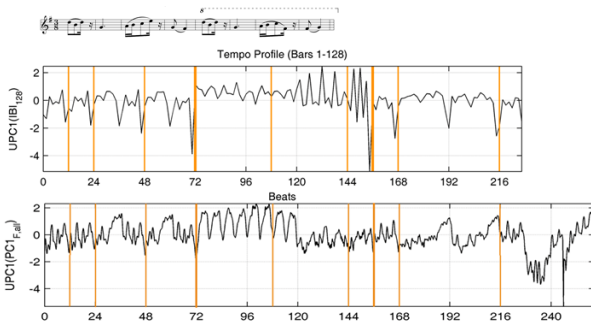
- what is perceived as (appropriate level of) expressiveness
- how can different performance parameters impact the listener
- how is aesthetic perception shaped by performance parameters



# performance analysis

## insights 1/3

- close relation between **tempo/dynamics and structure**:
  - ritardandi at phrase boundaries
  - tempo changes at structural boundaries
  - repetitions very similar
- performance sounds unnatural without these general trends
- no clear relation to timbre



# performance analysis

## insights 2/3

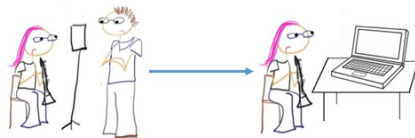
- perceptual relevance of “expressive” performance characteristics:
  - dynamics highest impact on ratings of emotional expression
  - expressive timing best predicts ratings of musical tension
  - sharpened intonation at phrase climax contributes to perceived excitement
- measured  $\neq$  perceived
  - e.g., measurable difference between “normative” and “expressive” performance does not necessarily lead to perception of expressivity
  - e.g., no correlation between measured and perceived vibrato onsets



# performance analysis

## insights 3/3

- Humans rate performances regularly (schools, auditions, competitions) but specific criteria are often badly defined
- use cases
  - music education
  - computer-assisted practice
  - pre-screening of candidates for music programs
  - provide insights into **technical and aesthetic descriptors** of human judgments
- most models still lack generalizability and reliability beyond simple note matching



# music performance analysis

## challenges

### ■ observations

- style dependent, lacking research beyond western classical music
  - data is manually annotated in most cases
  - most research
    - ▶ focused on piano and voice
    - ▶ descriptive and explorative
- 
- 1 datasets small, not general
    - ▶ automatic tools not reliable enough?
    - ▶ generality: instrument specific, performers, listeners
  - 2 unknown mapping of performance parameters to perception
    - ▶ isolation of parameter meaning tricky
    - ▶ hard to define expressivity, hard to control variables

# music performance analysis

## opportunities

- understanding why current MIR systems are of limited use to music psychologists and performance researchers
  - wrong measures of success?
  - miscommunication of system capabilities?
- score-based and performance-based information should be disentangled
  - lack of separation of core musical ideas and performance characteristics impedes differentiation of relevant and irrelevant information (example: music emotion recognition)
- cross-disciplinary approaches and methodologies can help
  - enabling larger scale perceptual studies with music data
  - interpretability of data
    - ▶ better understanding of music and its perception
    - ▶ better systems for music analysis and music generation

# summary

## lecture content

### ■ performance

- all music needs to be performed
- while the general performance characteristics are clear, their analysis is less clear

### ■ performance analysis

- 1 describes and formalizes commonalities and differences of performances

### ■ challenges

- 1 tricky to disentangle variables
- 2 unclear impact on listeners
- 3 hard to find reliable ground truth data

