

# TRACKING MELODIC PATTERNS IN FLAMENCO SINGING BY ANALYZING POLYPHONIC MUSIC RECORDINGS



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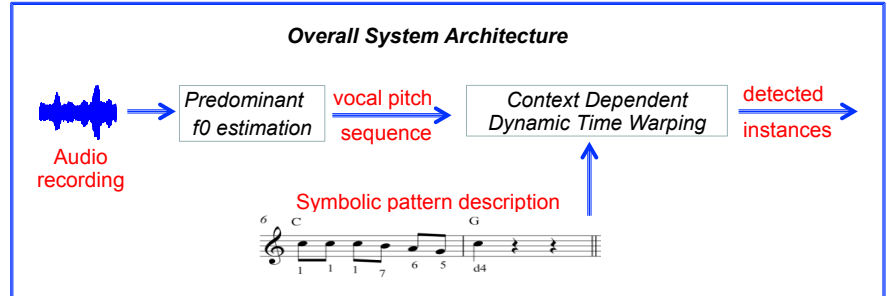
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## Goal

Study characteristic melodic patterns in Flamenco music. These patterns make given styles recognizable

## Approach

- **Stage 1:** Extract vocal pitch sequences from the audio recordings by means of a *predominant f0 estimation technique* [1].
- **Stage 2:** Detect instances of the patterns directly in the pitch sequences by means of a dynamic programming algorithm which is robust to pitch estimation errors (*extension of Context Dependent Dynamic Time Warping – CDDTW*, [2]).



## Flamenco music

- Oral tradition. Voice is an essential element.
- Usually available as raw audio. Sporadic metadata.
- Uses intervals smaller than the half-tone. Not strict with tuning. Melismatic.

## The fandango style

- Fandango is one of the most fundamental styles in flamenco music.
- Great number of variants but all fandangos have a common formal and harmonic structure.
- This study focuses on 30 Valverde fandangos and 30 Huelva capital fandangos.
- A number of characteristic patterns were defined in symbolic format by experts.
- These are heard in the initial representation of the thematic material and are fundamental to recognizing the style.

## Characteristic patterns in the Valverde fandango style

exp-1

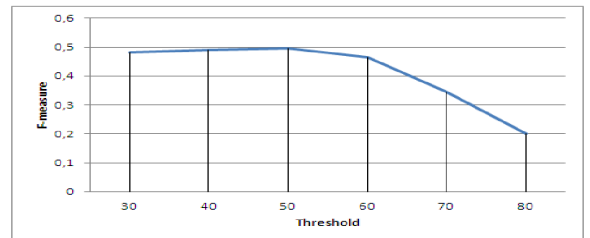
exp-2

exp-4

exp-6

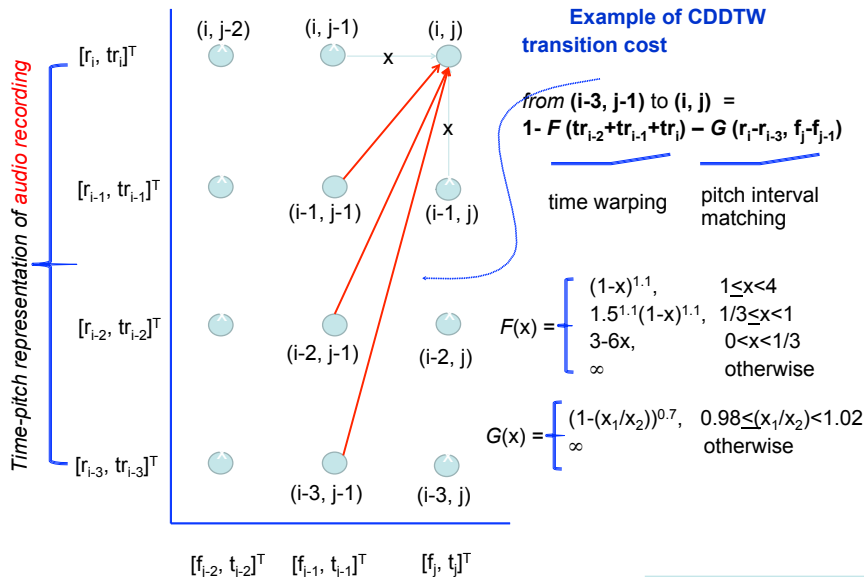
## Evaluation of Results

- Experiments with varying similarity threshold.
- Reasonably good performance despite melodic variation, polyphonic sources, melismatic content and note-duration variation.
- Overall: good precision, relatively low recall.



## Evaluation examples

- **exp-1:** exposition of the first phrase of the fandango  
✓ It is detected correctly in the first phrase of the Valverde fandangos and also in other phrases (leit-motiv).
- **exp-2:** pattern of the second exposition phrase in Valverde fandangos. Exhibits amplest tessitura.  
✓ It is detected with high precision, even for low values of the similarity threshold.



red: allowed

x: not allowed

Time-pitch representation of *pattern*

## References

- [1] J. Salamon and E. Gomez, "Melody Extraction from Polyphonic Music Signals using Pitch Contour Characteristics", *IEEE Trans. on Audio, Speech and Language Processing*, 20(6):1759-1770, Aug. 2012
- [2] A. Pikrakis, S. Theodoridis and D. Kamarotos, "Recognition of Isolated Musical Patterns using context dependent dynamic time warping", *IEEE Trans. on Audio, Speech and Language Processing*, 11(3):175-183, 2003

## Valverde fandangos (evaluation examples)

	Similarity Thresh.	Total Detected	True Positives	False Positives	Precision	Recall	F-measure
exp-1	50%	31	30	1	97%	33%	0.49
exp-1	60%	25	24	1	96%	27%	0.41
exp-1	70%	15	15	0	100%	17%	0.28
exp-2	50%	13	13	0	100%	43%	0.6
exp-2	70%	7	7	0	100%	23%	0.37