Topological Spaces of Motives of Brahms Op. 51 No1

(preliminary results)

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Séminaire MaMuX: mathématiques, musique, et relations avec d'autres disciplines

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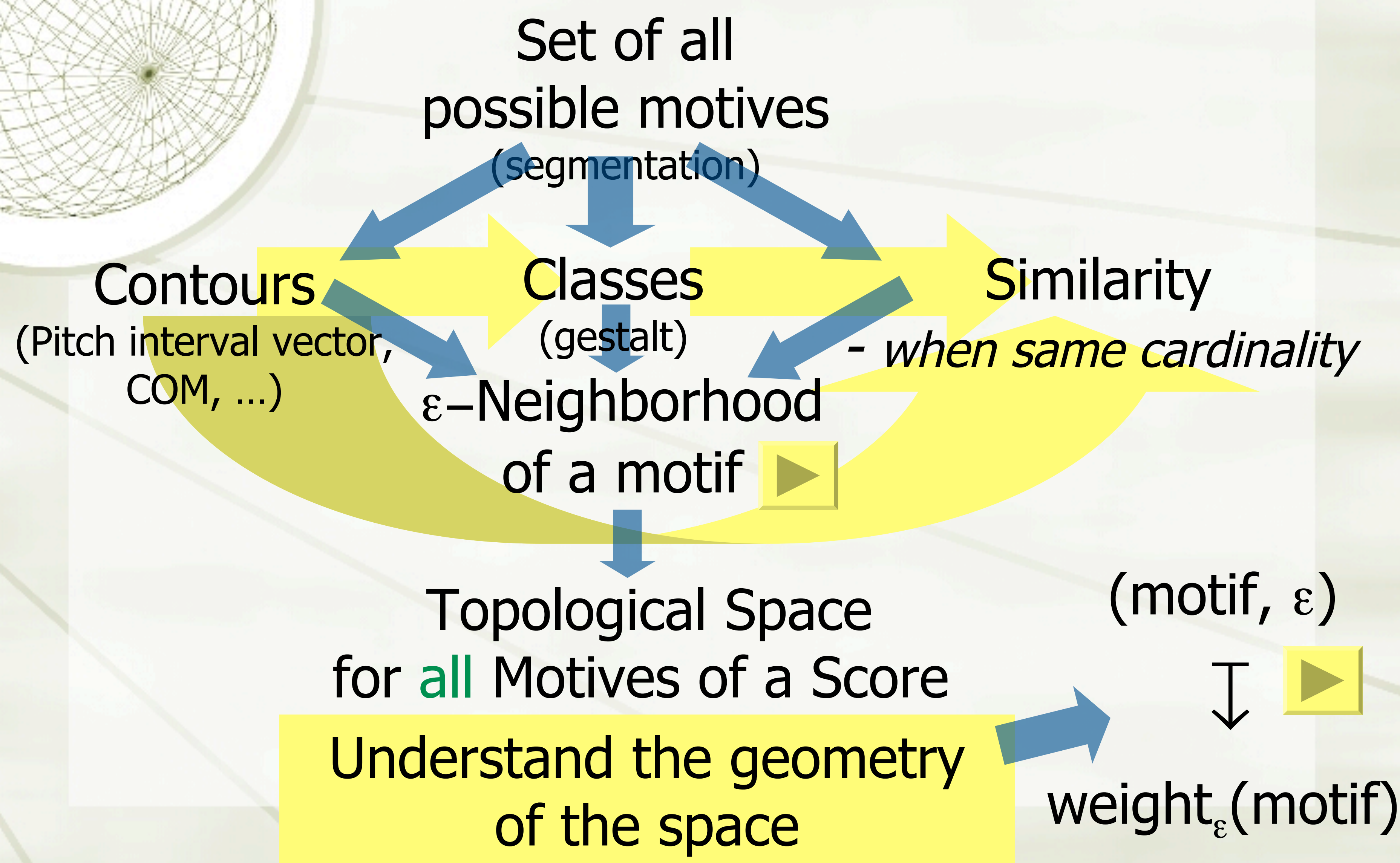
Content

- Topological Model & Implementation
- Application to Brahms Op.51 No.1
- Two additional Space Representations
- Final Remarks

Topological Model



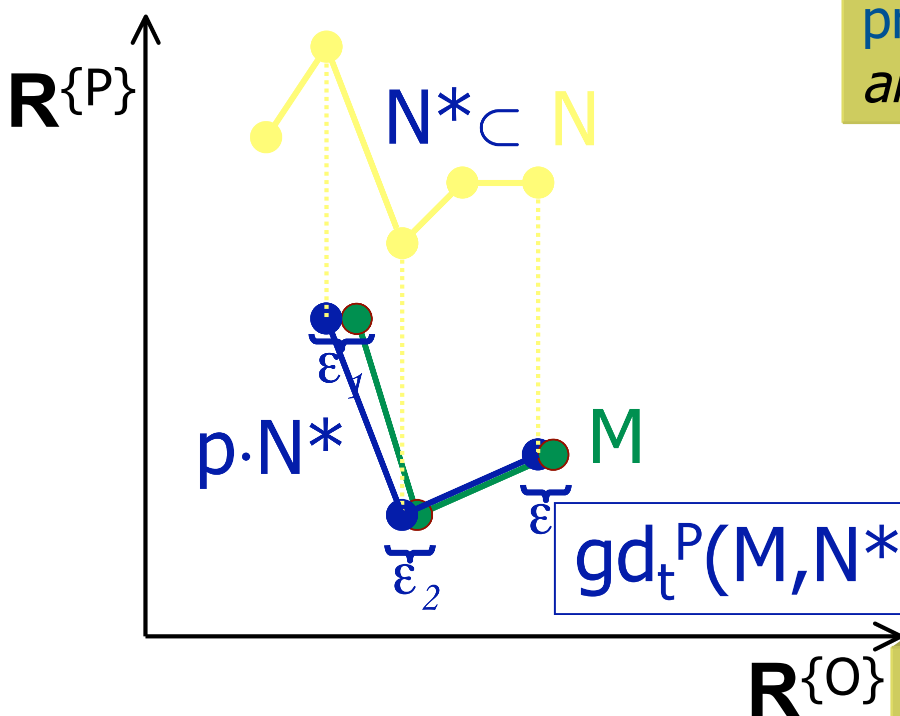
Neighborhood of a Motif

The ε-neighborhood of the motif M is

$V_\varepsilon(M) := \{N \in MOT \mid \exists\, N^* \subset N \text{ s.t. } gd_t^P(M,N^*) < \varepsilon\}$

Motif N is in the ε-neighborhood of motif M if:

proximity structure for
all motives *of any cardinality*



$gd_t^P(M,N^*) = (\varepsilon_1^2 + \varepsilon_2^2 + \varepsilon_3^2)^{1/2} < \varepsilon$

proximity structure for
motives *with same cardinality*

Weight Function

M a motif and $\varepsilon > 0$ a radius (similarity threshold)

N a motif with $card(N) \geq card(M)$

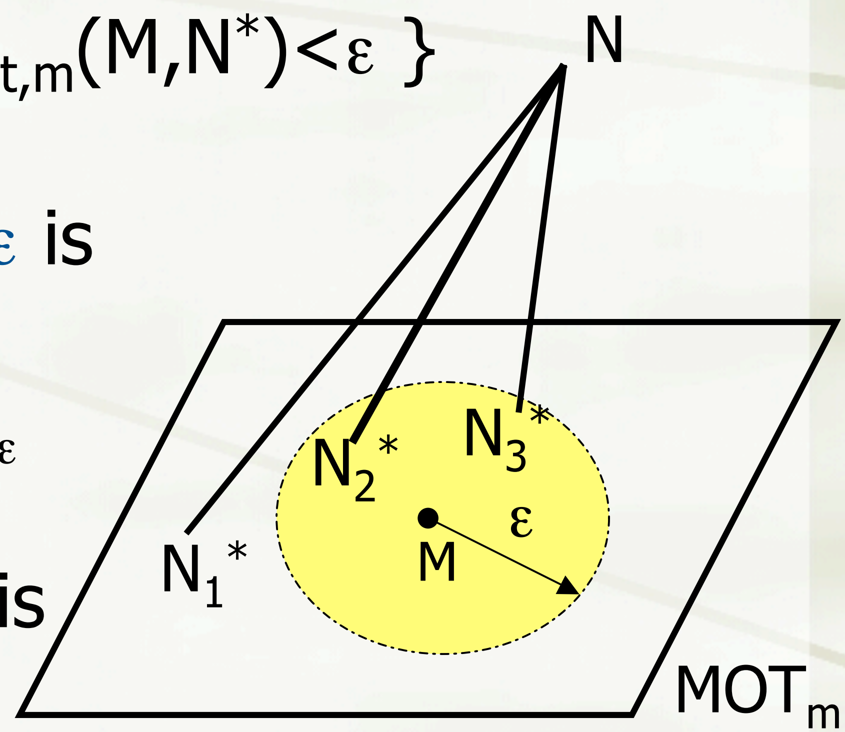
$$P_{M,N,\varepsilon} = \#\{ N^* \subset N \mid gd_{t,m}(M,N^*) < \varepsilon \}$$

The presence of M at radius ε is

$$presence(M,\varepsilon) := \sum_{N \text{ in score}} \tfrac{1}{2}^{n-m} \cdot P_{M,N,\varepsilon}$$

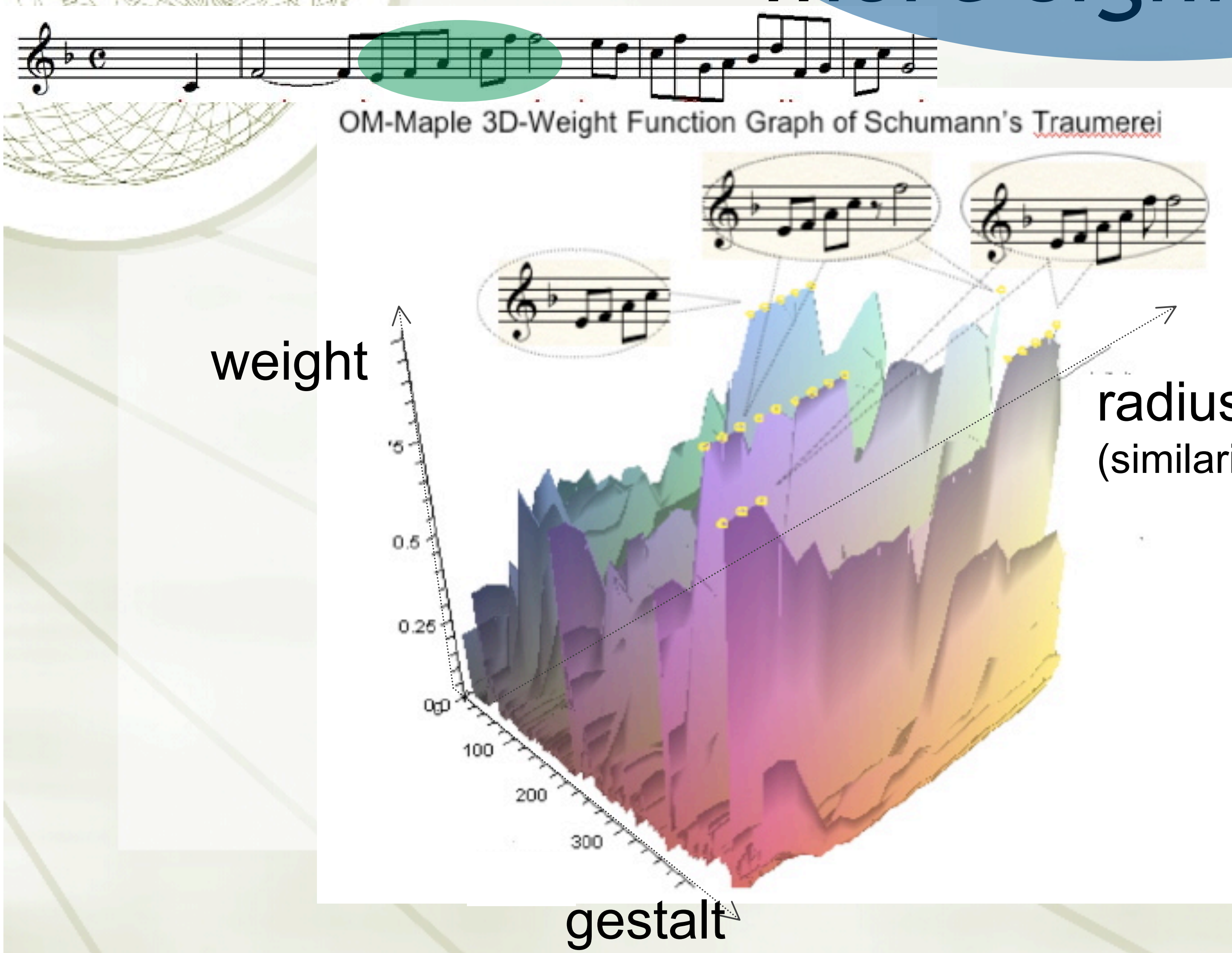
The content of M at radius ε is

$$content(M,\varepsilon) := \sum_{N \text{ in score}} \tfrac{1}{2}^{m-n} \cdot C_{M,N,\varepsilon}$$



$$Weight(M,\varepsilon) := Presence(M,\varepsilon) \cdot Content(M,\varepsilon)$$

Weight Graph: the higher the more significant

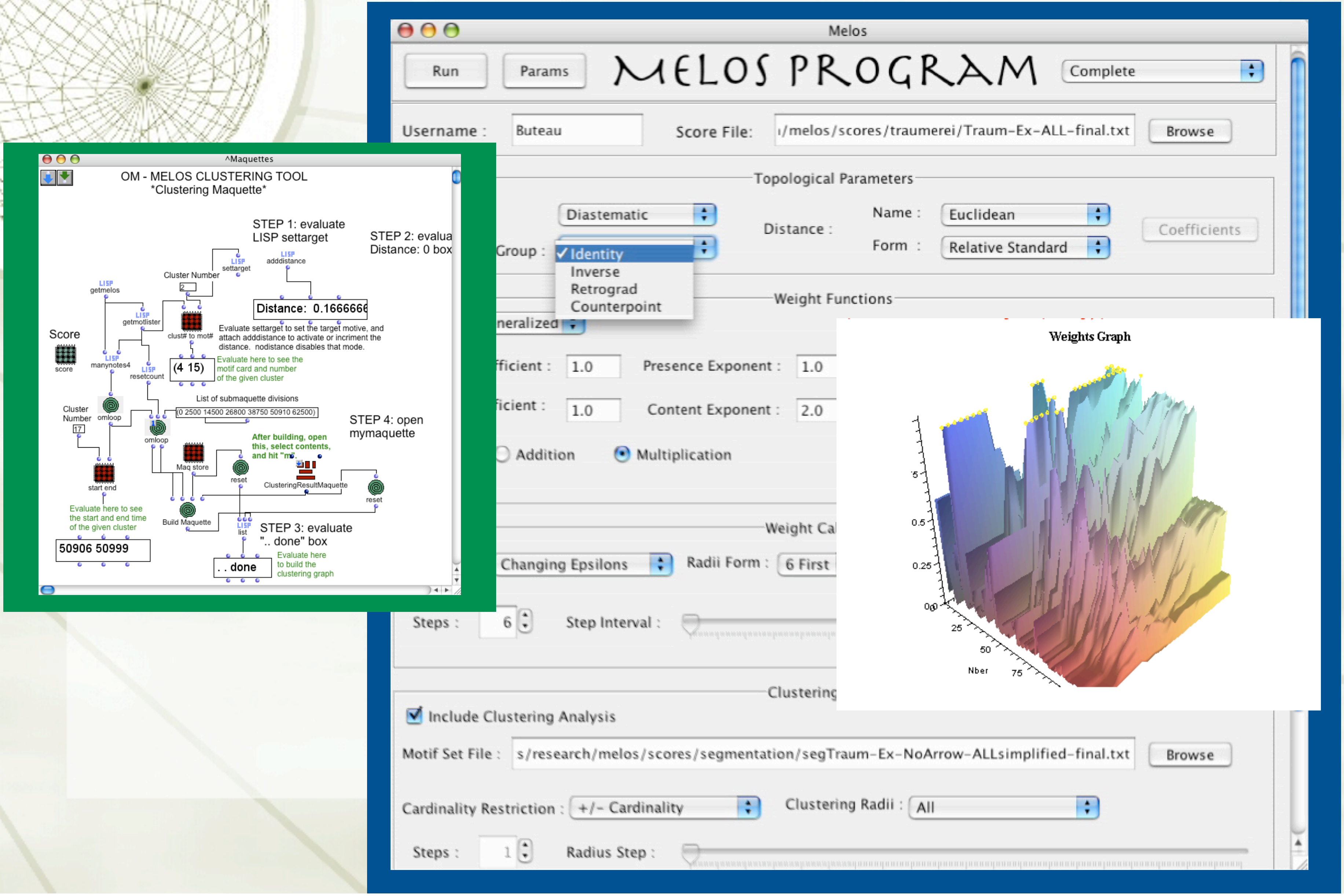


Our Approach: Motivic Topologies

Introduced by Guerino Mazzola (1994)
(MeloRubette: Zahorka & Mazzola)

Further developped by
Buteau & Mazzola (1998-2003)
Buteau (since 2003)
(OM-Melos: Buteau & Vipperman with Agon)

Implement: OM-Melos



Implement: OM-Melos

Some characteristics:

- Polyphonic music
- Automatic or semi-automatic segmentation
- Motives with non-necessarily consecutive notes
- Many model parameters: contour, par. groups, weight functions, …
- Many analyses each with a fixed motive representation
- Output Visualization:

<u>Space Representations</u> *(in OpenMusic and Maple):*

- Weight Functions
- Motivic Evolution Trees
- Clustering (dynamic tables)

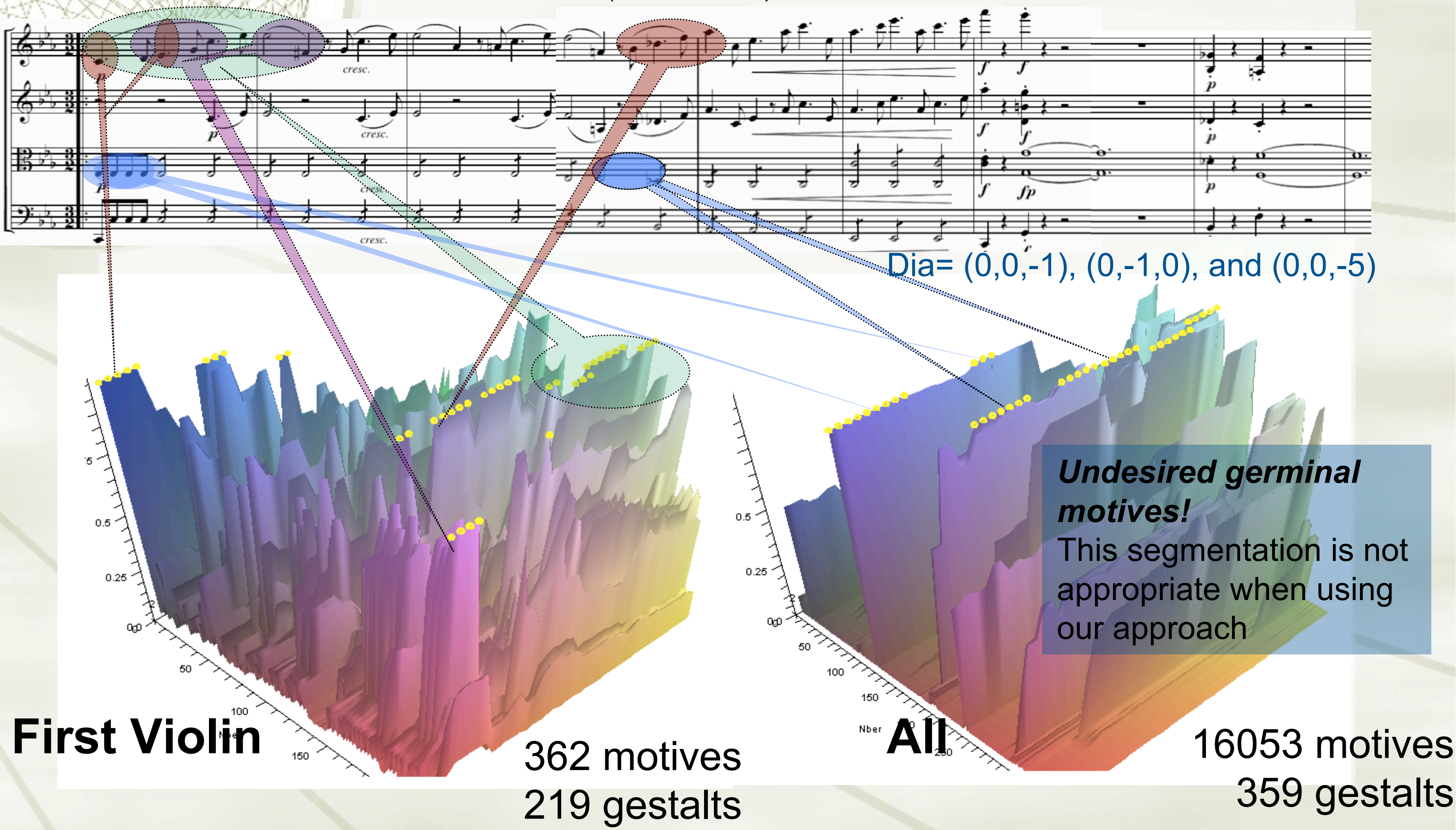
<u>Motives and Gestalt representations</u> in score *(in OpenMusic*)

Topological Space of Motives of Brahms Op.51 No.1

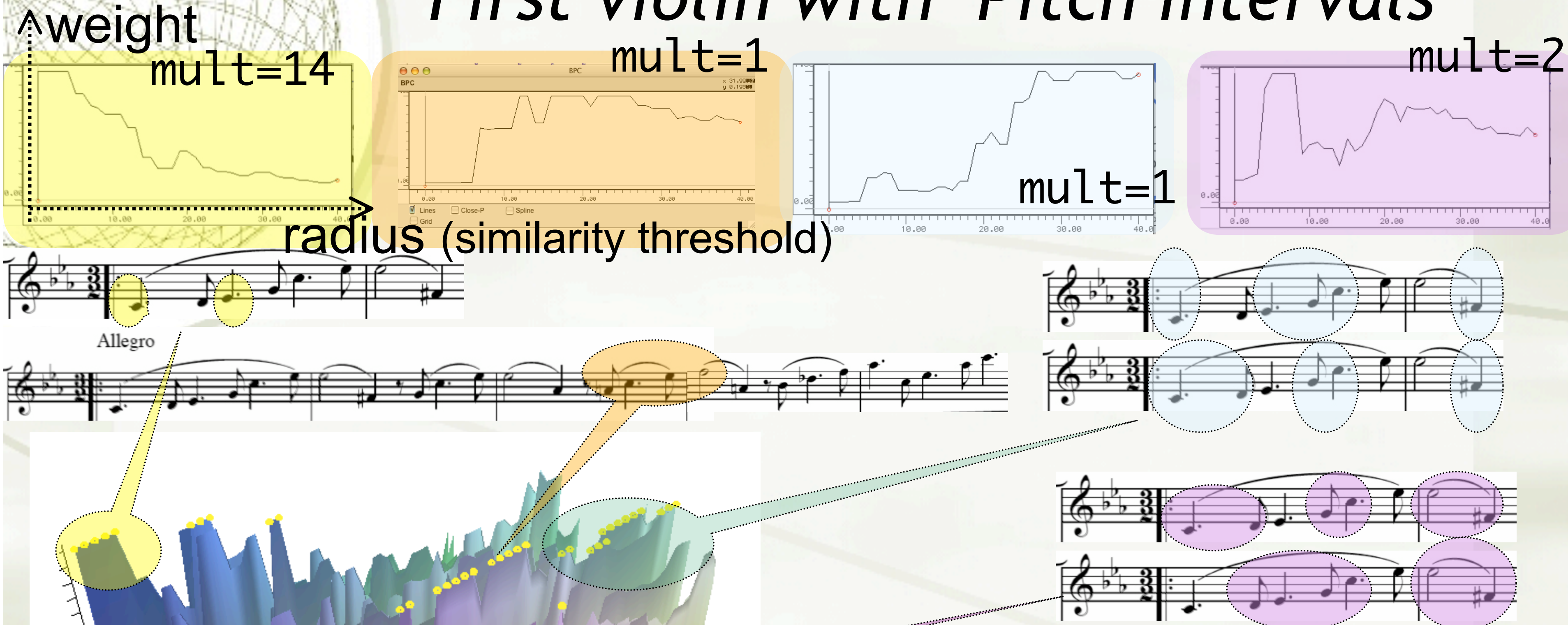
(preliminary results)

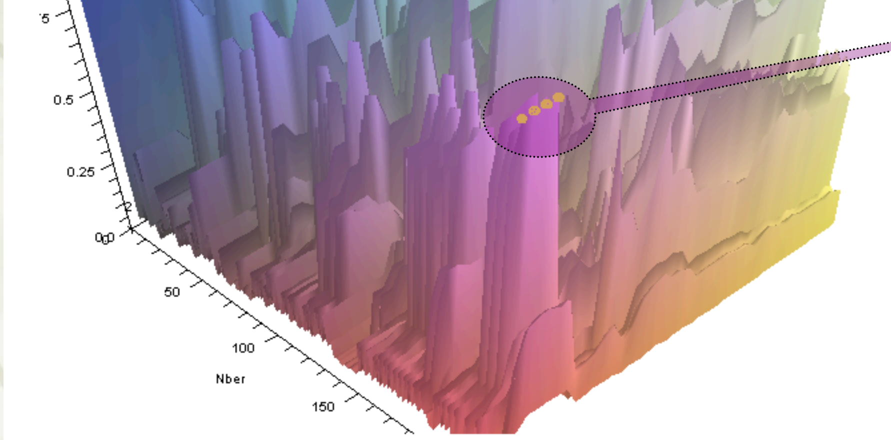
- Opening bars (1 - 10)
  - All
  - 1st Violin
- Exposition (bars 1 - 82)
  - Melody (in 3 voices)

Motivic Spaces of the Opening Bars (1-10): 1st Violon vs All



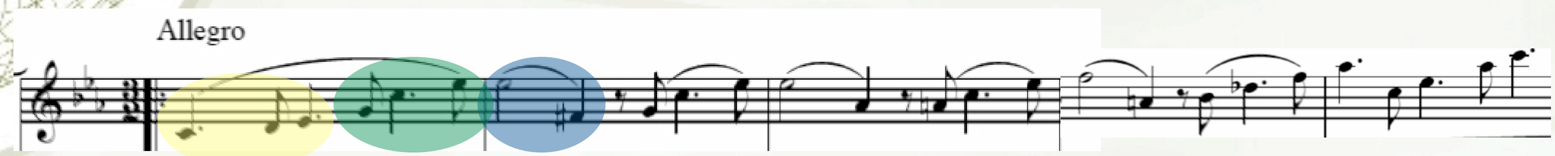
Motivic Space of Opening Bars (1-10) for First violin with Pitch Intervals



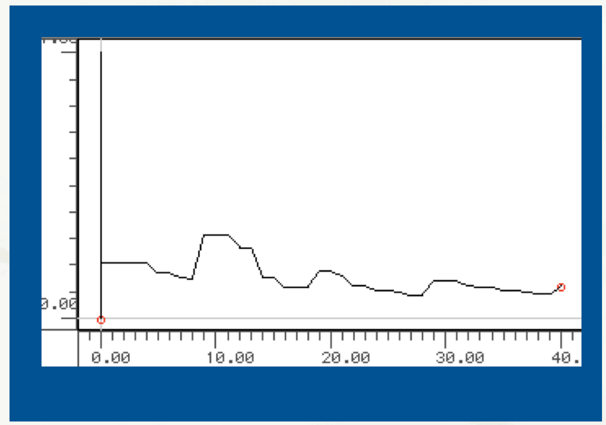


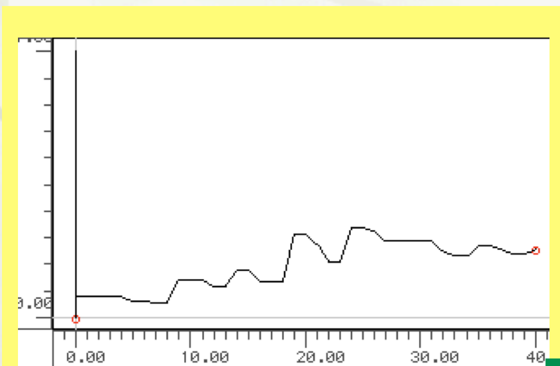
Motif Cardinality	Number of Motives	Number of Gestalts
2	80	15
3	98	64
4	88	66
5	59	44
6	28	22
7	8	7
8	1	1
TOTAL =	**362**	**219**

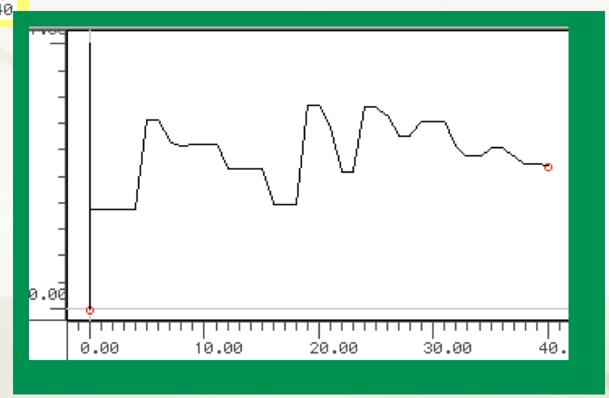
Forte's Motives in the Topological Space



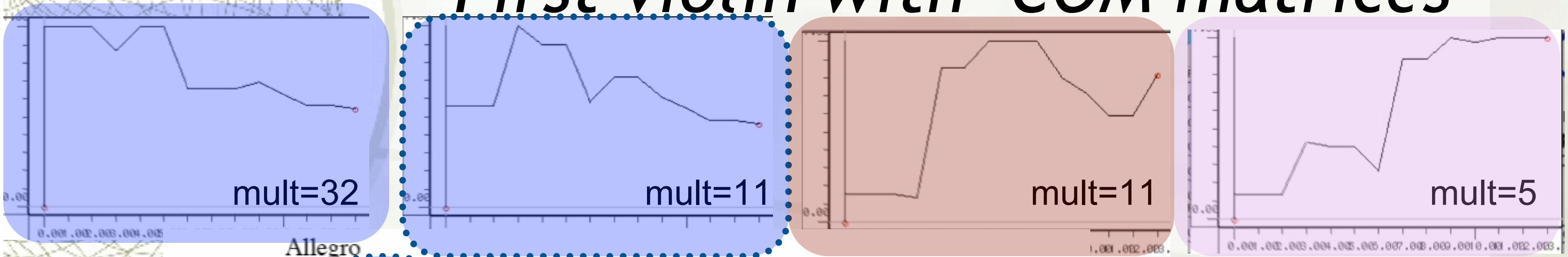
alpha beta gamma

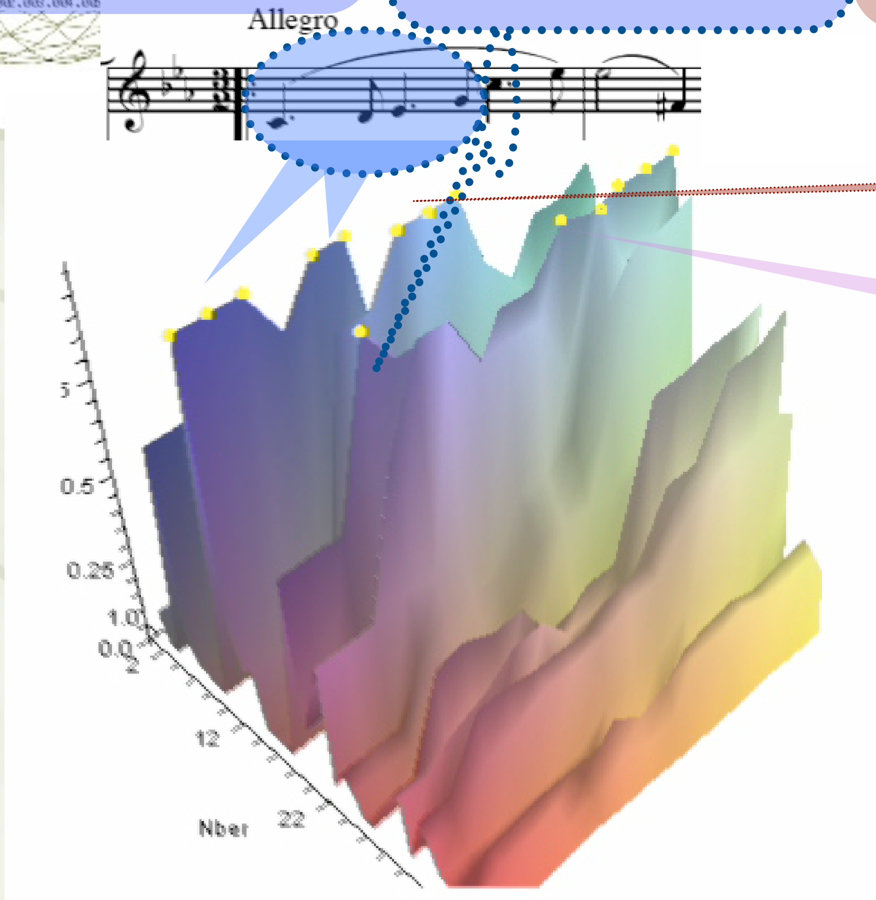


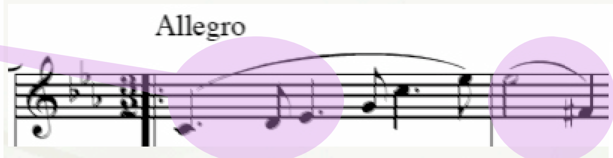




Motivic Space of Opening Bars (1-10) for First violin with COM matrices



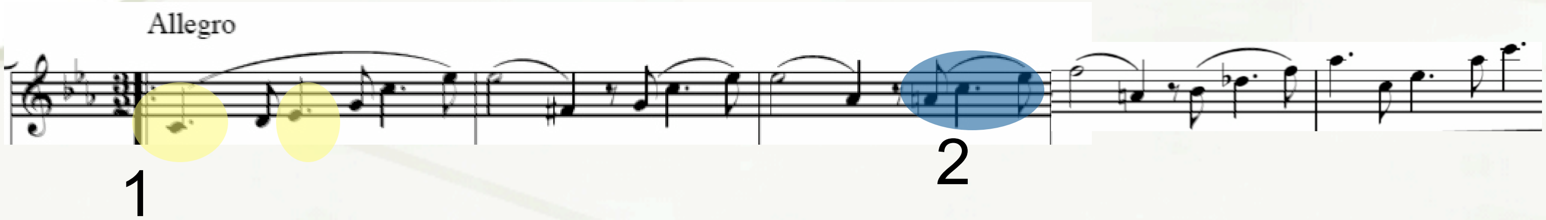




Motif Cardinality	Number of Motives	Number of Gestalts
2	80	3
3	98	6
4	88	8
5	59	9
6	28	7
7	8	4
8	1	1
TOTAL =	**362**	**38**

Exposition - First Results

(limitation of visualization implementation)



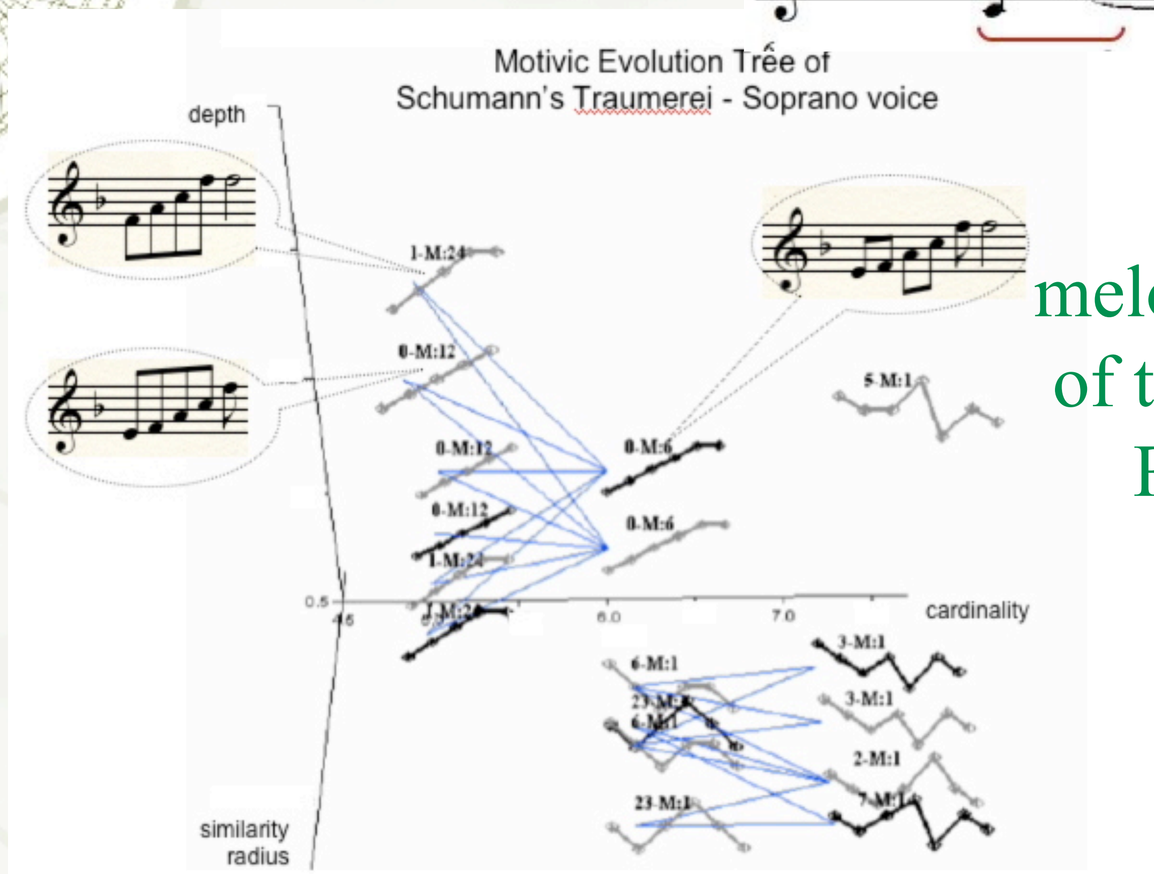
with pitch intervals (Dia, Id, REd)

with pitch intervals (Dia, Id, Abs)

Two Additional Visualizations

(exemplified with Schumann's Träumerei)

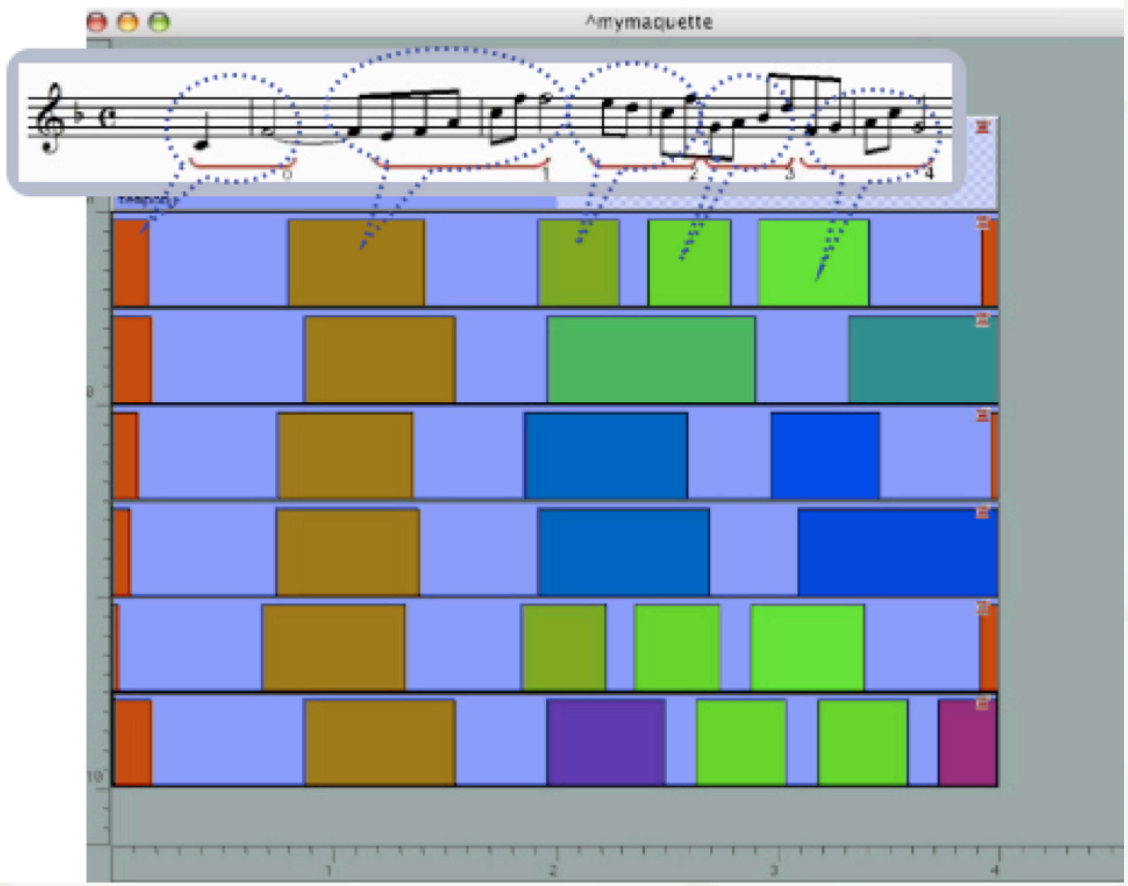
Motivic Evolution Tree (Maple)



"This is the signature melodic gesture of the piece…"
Repp (1992)

Schumann's Träumerei Melodic Clustering

(dynamic visualization in OpenMusic)



Final Remarks

- Results depend on the segmentation
  (e.g. repetitions in viola section should be excluded)
- Tedious manual segmentation
- Tedious manipulations for visualization
  (3 programs)
- Limitation of computations
  (depend on the number of motives & gestalts)
- Musical Significance of results
- Limitation of visualization
  (of 'large' spaces) - *next week…*
- *Preliminary* analysis of the quartet