



Aspects of a Romanian Syntactic-Prosodic Interface for an Intonation Prediction Module

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Functions of intonation in communication

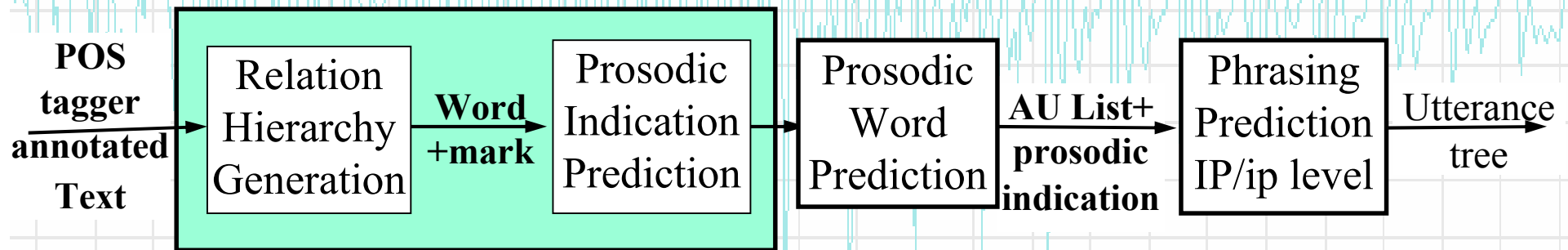
- Grouping of words (generate associative relations, phonological groups)
- Emphasizing words
- Differentiating meaning

The intonation generates local and global associative relations between words and/or group of words, which can partially overlap the syntactic relations.

The associative relations are generated within the communicative units at the enounce level. The utterance of a text within the communicative act involve an hierarchy of communicative units.

Prosody Prediction Module

In this stage of the Prosody Prediction Module (PPM) was introduced a module which transforms the word sequence of the input sentence into an optimal hierarchy of relations between words/groups of words.



Block diagram of the Utterance tree Prediction

Intonation in verbal communication

- Every communicative unit contains a word/group of words that expresses the “**theme**” or the “**fact**” referred by the unit and one or two words/groups which introduce other **referential** elements about the presented “fact” .
- Ones of the functions of intonation are to mark the communicative units by phrasing and to mark the internal structure of the units by proper melodic contour corresponding to the words accordingly to their functions.

Associative relation structures

A communicative unit has a **thematic element** and **two referential elements** (element=word or group of words)

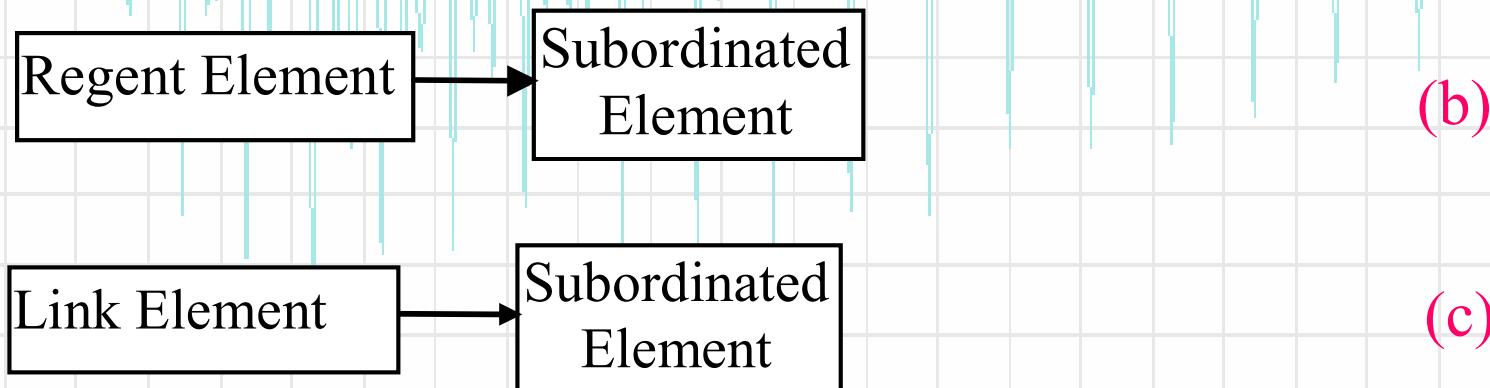
Within an associative relation we named the **thematic element** as *Link element* (correlative element) between a *Regent* and a *Subordinated* elements - (a)



Associative relation structures

The **Link** element may be not present in the case of a relation with two words or two groups of words (e.g. in the case of a NP followed by a VP) - **(b)**

A relation with two elements may contain the **Link element** but a *single referential element* (word or relation). – **(c)**



Associative relation structures

The **focus** of a sentence was annotated as an attribute assigned to any element in a relation.

The associative relation hierarchy was built by taking into account the lexical and morpho-syntactic aspects of the input text.

The hierarchy of associative relations between words and/or group of words was built according to the constraints imposed by the presence of certain *function words* and certain aspects related to the syntactic elements (VP, NP, AP) and their syntactic structures.

Associative relation structures

There are more POS labels (verbs, adverbs, nouns) which can constrain a word to be set as a *Link* element. The auxiliary verb *to be* locally relates the adjacent words (e.g. the subject and the nominal predicate).

The nouns which derive from verbs can be used as *Link* elements (e.g. *actualizare* ‘updating’, *organizare* ‘organization’, ‘organizing’) if there is no other incompatible higher rank constraint in the neighborhood.

Melodic contours of *Link* elements

[Nu_F- există_L-(nicio-rațiune)]-[ca aportul_L(co-autorilor)]_L- [să fie-diferit]

- This uttered text is organized into a relation with three complex elements (sub-relations) and correspond to the enounce structure:

[Main clause]+[ca+NP]+[să+VP]

- In the first sub-relation the verb *există* ‘there is’ is the *Link element* between the negation word *nu* ‘no’ and the group *nici o-rațiune* ‘no reason’. In this case the constrain of focus on the negation in the first position agrees with a lower ranked constrain of **Link** on the verb in the second position

Melodic contours of *Link* elements

[Nu_F-există_L-(nicio-rațiune)]-[ca aportul_L(co-autorilor)]_L-[să fie-diferit]

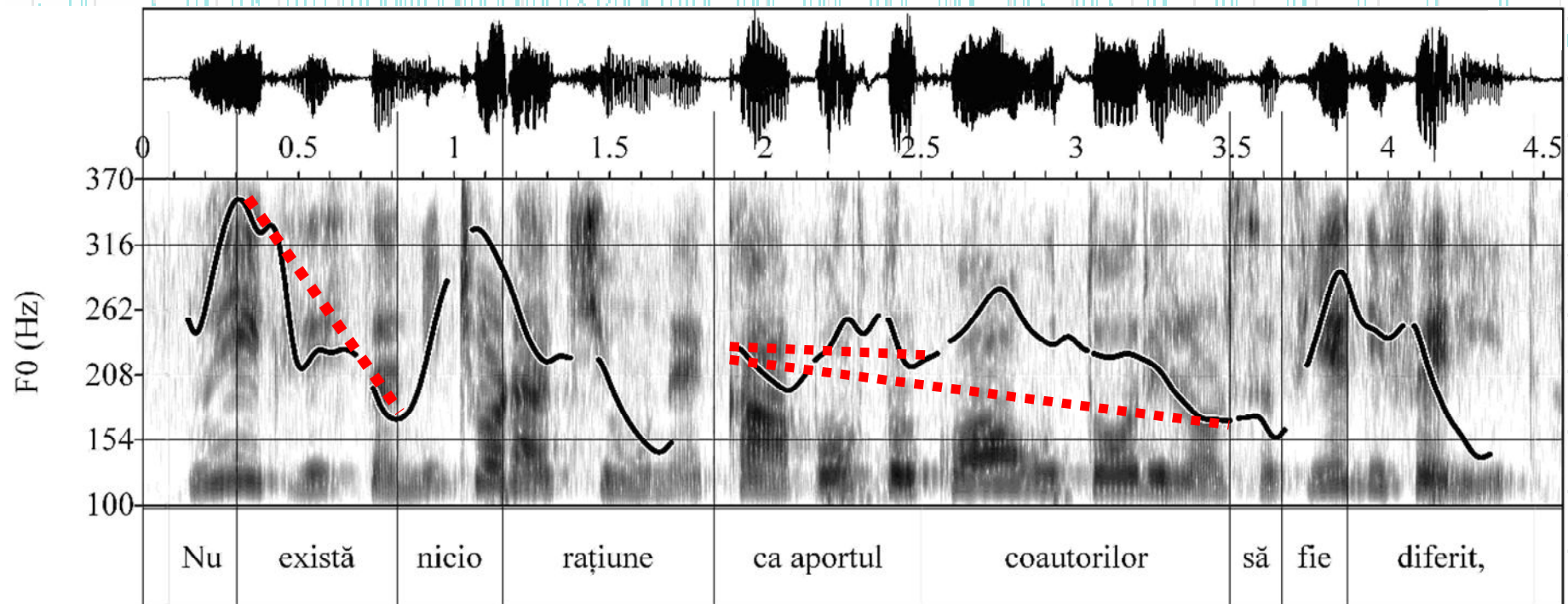
[Main clause]+[ca+NP]+[să+VP]

- The second relation begins with the *Link* element *ca aportul* ‘for...contribution’ has no *Regent* element, while the next compound noun (*co-autorilor* ‘coauthors’) is a *Subordinated* element. The whole sub-relation is a *Link* element for the higher relation.
- The third sub-relation by the constrain of focus (local) on the predicative verb at conjunctive .

Melodic contours of *Link* elements

[Nu_F- există_L-(nicio-rațiune)]-[ca aportul_L(co-autorilor)]_L- [să fie-diferit]

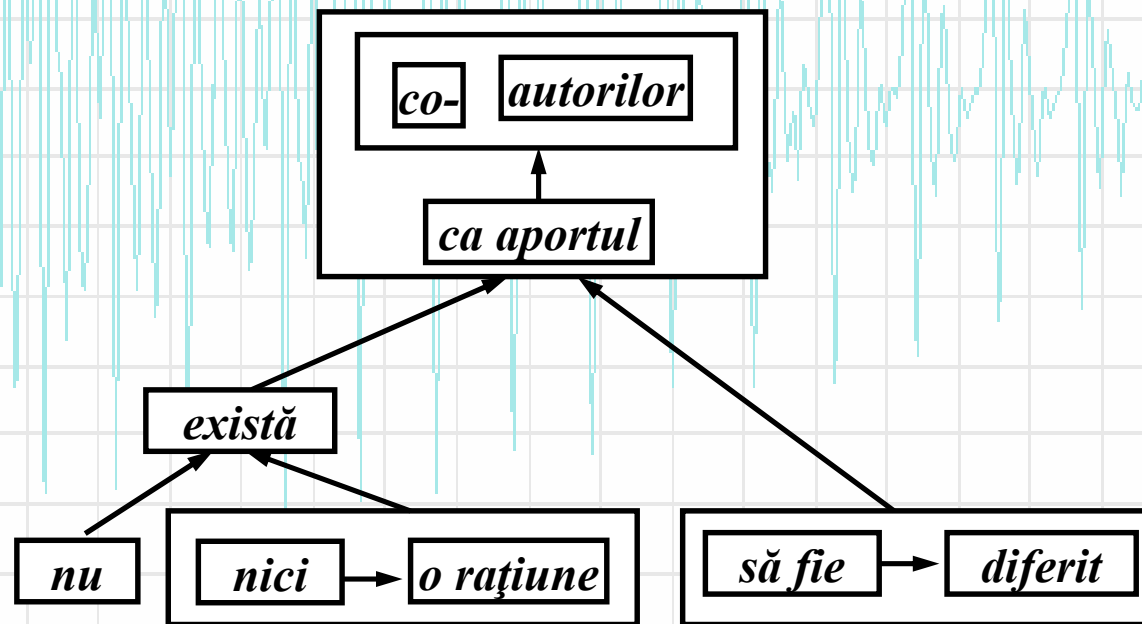
‘There is no reason for the co-authors' contribution to be different.’



Hierarchy of the associative relations

- The hierarchy of relations corresponding to the text:

[Nu_F- există_L-(nicio-rațiune)]-[ca aportul_L(co-autorilor)]_L- [să fie-diferit]



Focus Prediction

- Focus induced by some function words (ex. *nu*, *tocmai*, *totuși*, *chiar* ...)
- *Nuclear* stress rule (*NSR*) stress is assigned to the rightmost stressable ... makes the objects the “informational *focus*”
- **A variant of Topic-Focus Articulation (TFA) algorithm**

Functional labels

To describe melodic contour of the prosodic units we used functional labels, whose significance is given below:

- **PH (PUSH)** and **PO (POP)** annotate the delimitative accentual units of a phonological phrase;
- **F (FOCUS)** is assigned to a prosodic unit whose target tone reaches the highest pitch level in an affirmative statement;
- **L (LINK)** annotates a prosodic unit endowed with a predicate function (Link). It links the first AU/AU group to the last one within an intermediate or intonational phrase;
- **PU (POP-UP)** is assigned to a particular type of POP event. The tonal level is low on the accented syllable and rises on the next unaccented syllable.

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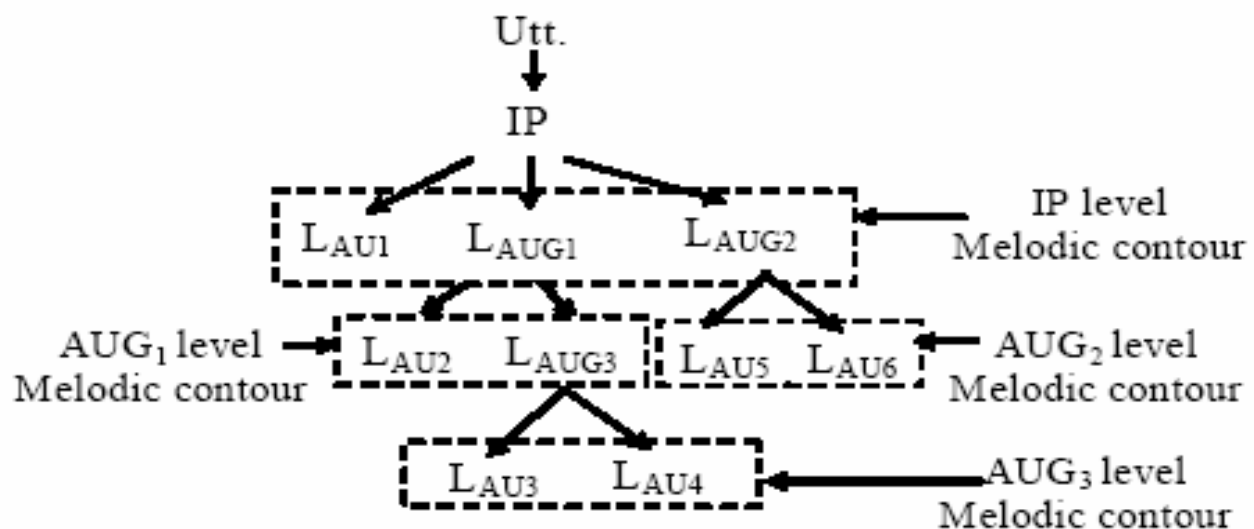
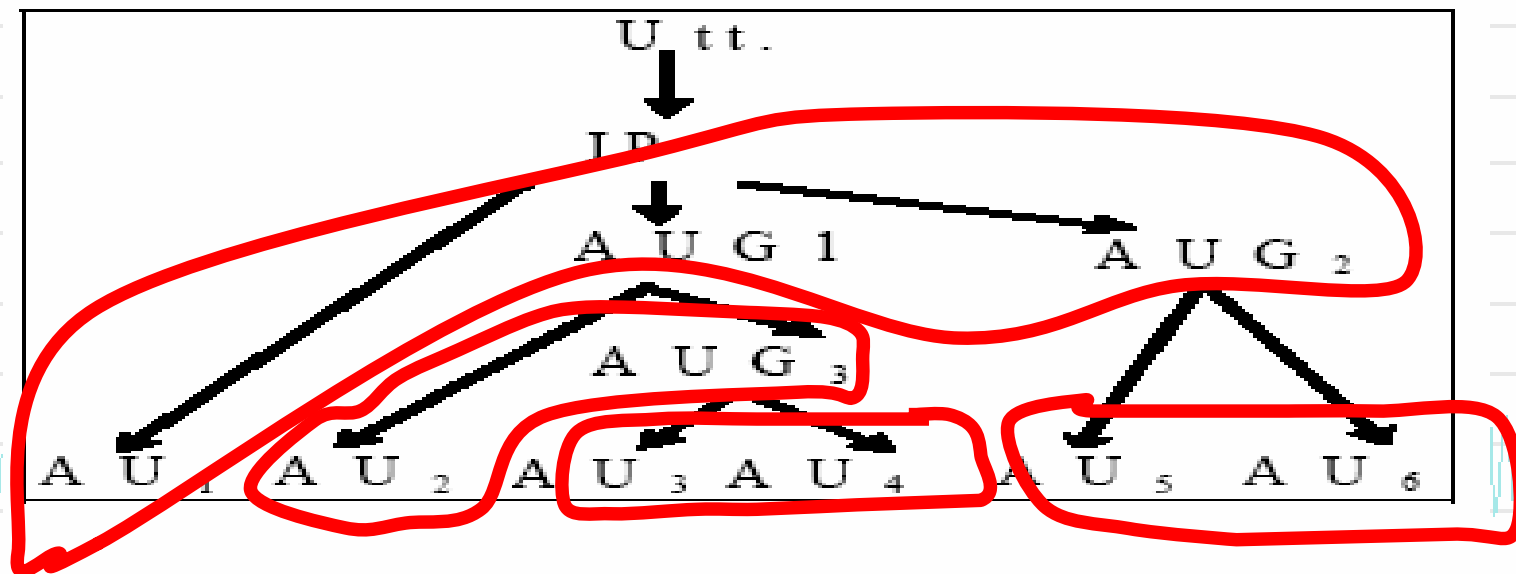
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In a descending contour, PUSH marks the beginning of a phrase, while POP marks its end. In neutral intonation, a PUSH unit is more prominent than a POP one

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The PPM Output



0:02:00 0:02:01 0:02:02 0:02:03 0:02:04 0:02:05 0:02:06 0:02:07 0:02:08 0:02:09 0:02:10 0:02:11 0:02:12 0:02:13

Prediction of intonation. A case study

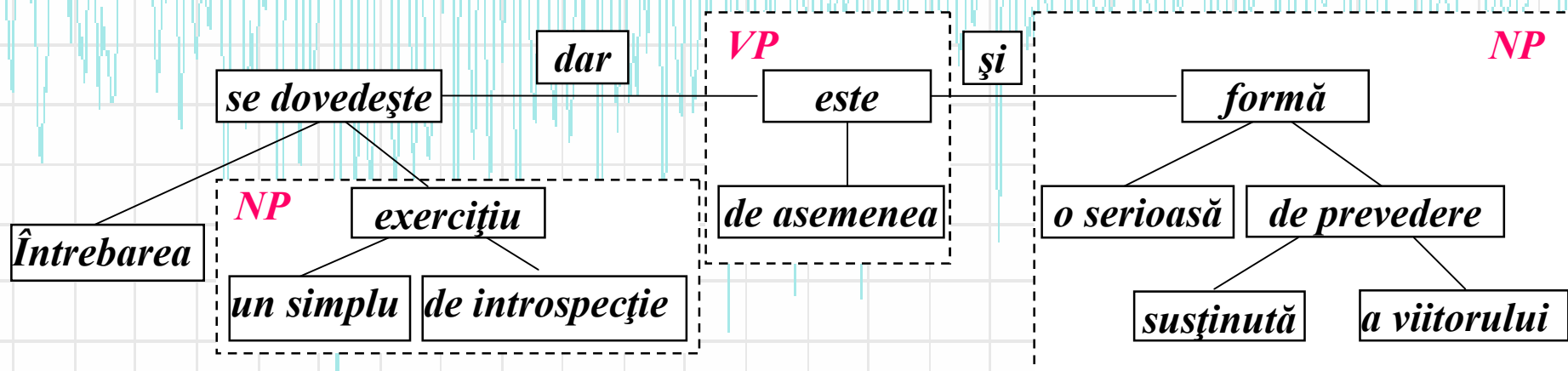
We illustrate the F0 contour prediction for the following Romanian input text:

Întrebarea se dovedește un simplu exercițiu de introspecție, dar este de asemenea și o serioasă formă de prevedere susținută a viitorului.

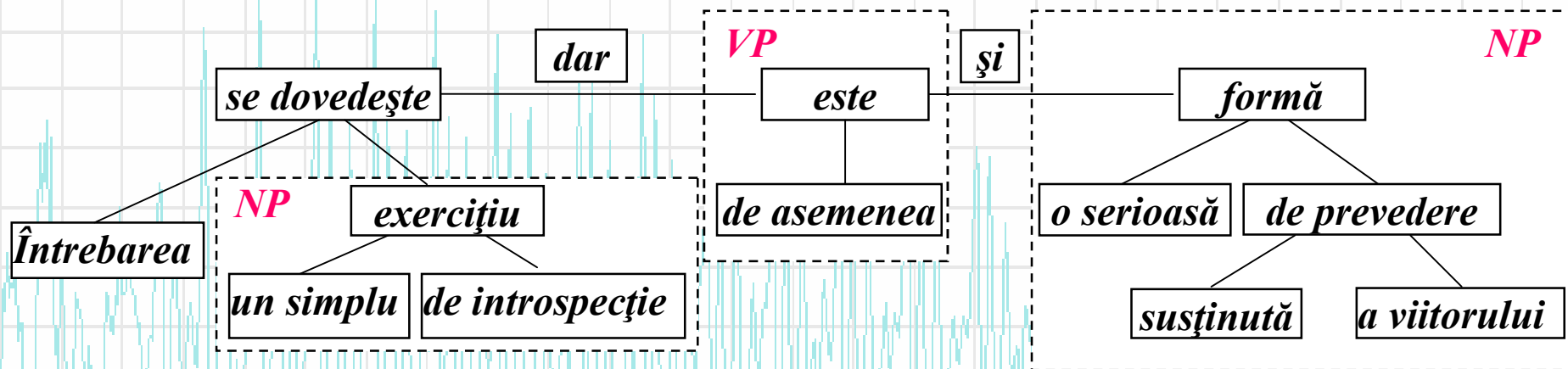
‘The question proves to be just an exercise of introspection, but is also a serious means of sustained foreseeing of the future.’

Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.

- The PPM analyzes the POS-annotated input text,
- The PPM uses certain elements of the syntactic structure and maps the words of the input text into a hierarchy of associative relation.



Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.



Sets prosodic indications (constrains) deduced from the text analysis:

- **IP_beg** – *dar, și* (is followed by a long NP);
- **L_mark** – *de asemenea* imposes a high constrain of Link. In this case a subrelation of Link function is generated by the text *dar este de asemenea*
- **GR_mark** – (*serioasă /formă*), (*de prevedere/ susținută*) (*a / viitorului*);
- **F_mark** - marks the focused word of an IP

Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.

Associative relations :

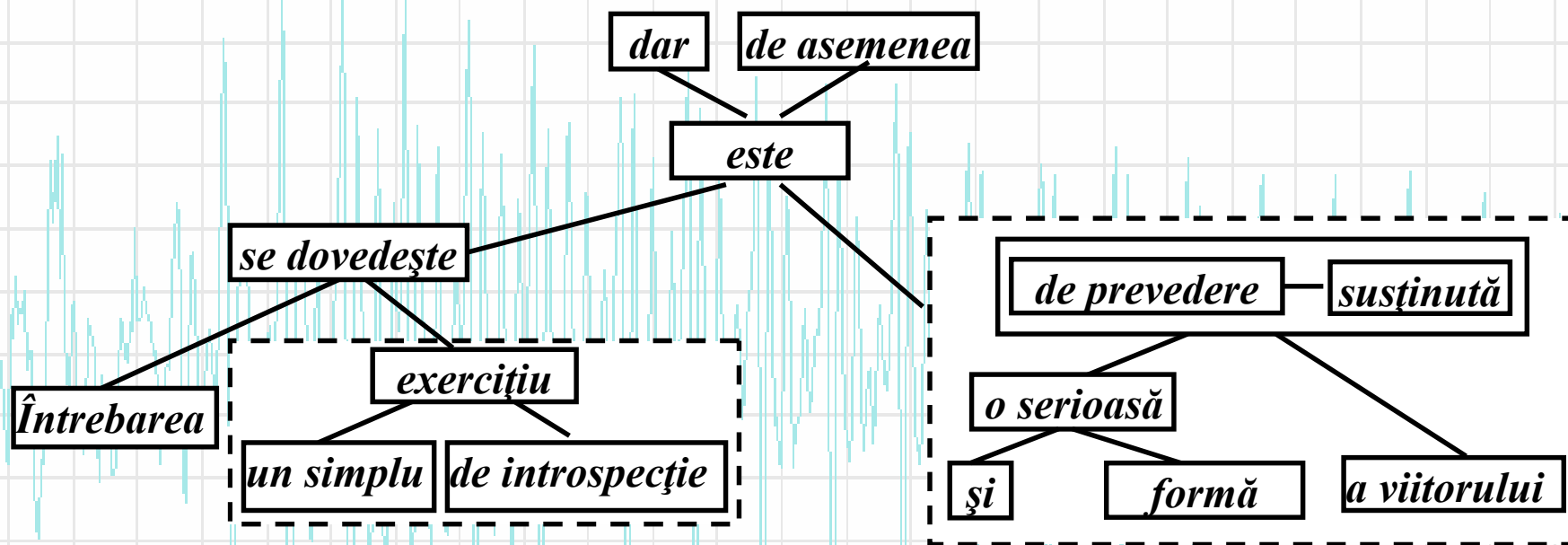
R1: *un simplu – exercițiu - de introspecție.* -> **L_mark** on *exercițiu*

R2: *întrebarea - se dovedește - R1* ('the question proves to be' –R1)
– SVO. -> **L_mark** on the verb *se dovedește*

R3: *și o serioasă - formă* -> **L_mark** on *formă*

R4: *R3-(de prevedere susținută)_L -(a viitorului)* ('of sustained foreseeing of future') ->L constrain on the *de prevedere* is applied to the whole group. Also -> a local focus on article *a* of the *noun in the genitive case*.

Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.



In the next steps the hierarchy of associative relation and prosodic indications are translate into:

- a prosodic structure
- melodic contours descriptions with functional label sequences

Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.

Based on **IP_beg** indicator, the Phrasing Prediction Module groups the PWs (AUs) of input text into three IPs (IP1, IP2 and IP3).

The text fragments corresponding to the three IPs are given below:

- **IP1:** *Întrebarea se dovedește un simplu exercițiu de introspecție*
'The question proves to be just an exercise of introspection'
- **IP2:** *dar este de asemenea* 'but is also'
- **IP3:** *și o serioasă formă de prevedere susținută a viitorului.*
'(also) a serious means of sustained foreseeing of the future.'

Generation of an Associative Relation Hierarchy. Prediction of the Prosodic Indications.

For each IP based on prosodic indications, the Melodic Contour Selection (MCS) generates the following melodic contours:

➤ **IP1** ← **PH/L/(PH+F/L/PU)PO+F**

➤ **IP2** ← **PH+F/L/PU**

➤ **IP3** ← **(PH+F/L/PO)PH+F(PH+F/PO)L/PO]**

Conclusions

- In natural utterances, prosodic phrasing is a consequence of the speaker's representation of the uttered text.
- This representation converts the word sequences into a hierarchy of local and global associative relations with two or three elements.
- The hierarchy of associative relations between the words and/or group of words can be built according to the constraints imposed by the presence of certain function words and certain aspects related to the syntactic elements (VP, NP, AP) and their syntactic structures.
- The hierarchy of associative relation can be easily translated into a prosodic structure.