Temporal relations are binary relations that connect temporal events or temporal expressions in texts. On the other hand, texts display discourse structures, as those expressed by Rhetorical Structure Theory (Mann and Thompson, 1988). Different authors suggested that temporality should manifest an intimate correlation with the discourse structure (Asher and Lascarides, 2003). This paper indicates a method that leads to a quantitative investigation of this connection and shows to what extent the link could be used for two purposes: reducing the human effort in manual annotation of temporal relations and improving the automatic annotation of temporal relations.

The experimental data we are using for our study consists of twelve texts from the RST Discourse Treebank (Carlson et al., 2003) which have been found to be also annotated for temporal expressions, events and relations, in the TimeBank corpus1.

The original RST annotation evidences RST relations between elementary discourse units (edus) which have the size of a clause or smaller. The temporal annotation marks temporal expressions, events, signals and their links, according to the TimeML standard2.

To each edu in the original RST annotation we add the computed vein expressions (Cristea et al., 1998) as sequences of units that display maximum coherence and cohesion among all sequences formed with units of the text which include the current unit, and which have been collected from the RST discourse structure by exploiting the nuclearity marking. Veins are proved to give focused summaries of the text from the perspective of each unit. Reading the text assembled as the sequence of units of a vein expression always results in a short story that makes sense and in which one can find no or extremely few unsolved reference expressions (unanchored anaphors). The obvious claim that we want to investigate is that a similar relationship as the one between discourse structure and referentiality should also exist between discourse structure and temporality.

The work presented in this paper involves the following steps:

1. **Pre-processing of the original files.** The original Lisp-like notation of the RST structure in the RST Discourse Treebank is automatically transcribed onto an XML notation. To each edu, its vein expression is computed and added.

2. **Merging of the discourse structure and the time annotations.** The original RST+veins annotation is fused with the TimeML annotation (Cristea and Butnariu, 2004). The resulted information includes RST structure, vein structure, and temporal structure.

3. **Evaluation.** To determine quantitatively the relation between discourse structure and time, we perform four types of evaluations:

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1 http://www.timeml.org/timebank/timebank.html
2 http://www.timeml.org/timeMLdocs/AnnGuide14.pdf
(a) **relations-on-the-veins evaluation**: for each temporal relation, we count whether or not the second term (a time expression or event) belongs to a unit included on the vein expression of the unit the first term belongs to.

(b) **annotation effort evaluation**: for each time expression we compute how many units back the second term is located, if computed on the vein versus computed linearly. This way we have an indication of the effort saved in manual annotation of temporal links if the annotator would use the vein of the unit the temporal expression is located on, as an abridged version of the whole original text.

(c) **how different types of temporal relations behave in connection with the discourse structure?**: we perform the evaluation reported at (a) for each type of temporal relation and sort the resulted values in descendent order.

(d) **how temporal relations behave in connection with different types of rhetorical relations?**: on the temporal relations that fail to find antecedents along veins we investigate the types of rhetorical relations involved.

The evaluation shows that the expectations are fulfilled to a great extend, in the sense that temporal links are found to be mainly located on the veins of the discourse structure. They also show that there is a subset of temporal relations that behaves better than the rest in correlation with the discourse structure. Mainly the bad performance characterises relations involving events indicating indirect speech. It seems that speech act events do not actually correlate with the discourse structure. This is proved reciprocally: the class of verbs involving speech acts anchors temporal relations addressing co-terms outside veins, and the failings to find co-terms in time relations on the veins happen mainly around the ATTRIBUTION rhetorical relation, which is the one involving speech acts.

The study evidenced a method to quicken the manual annotation of temporal relations in texts which include already a discourse structure annotation, known to be very time consuming and expensive (Pustejovky et al., 2002): an interface could be build to hide to the annotator the whole text excepting the units belonging to the vein of the unit containing the time expression s/he is concentrated upon. Automatic annotation of temporal relations could also benefit provided it is done in correlation with the discourse parsing.

The long version of the paper will provide numerical data regarding the evaluation as well as examples.

**References**

1. Asher, N. and Lascarides, A. (2003): Logics of Conversation. Cambridge University Press
2. Cristea, D.; Ide, N.; Romary, L. (1998): Veins Theory. An Approach to Global Cohesion and Coherence. In *Proceedings of Coling/ACL ’98*, Montreal
3. Cristea, D. and Butnariu, C. (2004): Hierarchical XML representation for heavily annotated corpora, in *Proceedings of the LREC 2004 Workshop on XML-Based Richly Annotated Corpora*, Lisbon, Portugal
4. Mann, W.C., and Thompson, S.A. (1988): Rhetorical Structure Theory: Toward a Functional Theory of Text Organization. Text 8(3), 243–281

5. Carlson, L.; Marcu, D. and Okurowski, M. (2003): Building a Discourse-Tagged Corpus in the Framework of Rhetorical Structure Theory, in Current Directions in Discourse and Dialogue, pp. 85-112, Jan van Kuppevelt and Ronnie Smith eds., Kluwer Academic Publishers

6. Pustejovky, J.; Belanger, L.; Castaño, J.; Gaizauskas, R.; Hanks, P.; Ingria, B.; Katz, G.; Radev D.; Rumshisky, A.; Sanfilippo, A.; Sauri, R.; Setzer, A.; Sundheim, B.; Verhagen, M. (2002): NRRC Summer Workshop on Temporal and Event Recognition for QA Systems