Semantic Approach for the Spatial Adaptation of Multimedia Documents

Azze-Eddine Maredj and Nourredine Tonkin
Research Center on Scientific and Technical Information (CERIST)
Ben Aknoun, Algiers, Algeria
Email: {amaredj, ntonkin}@mail.cerist.dz

***Abstract*—With the proliferation of heterogeneous devices (desktop computers, personal digital assistants, phones), multimedia documents must be played under various constraints (small screens, low bandwidth, etc). Taking these constraints into account with current document models is impossible. Hence, generic source documents must be adapted or transformed into documents compatibles with the target contexts. The adaptation consists of modifying this specification of the document in a minimal way to lead it to satisfy the target profile. The profile defines constraints that must be satisfied by the document to be played. At this level, the transgressive adaptation becomes necessary when no specification model exists to satisfy this profile. We focus on the spatial dimension of a multimedia document and we provide an approach for the spatial adaptation that permits to best preserve the initial document semantic. In the proposed transgressive adaptation, the relations that do not comply with the target profile are not most often replaced by the closest ones due to the fact that their immediate neighboring relations have the same similarity degree whereas there may exist differences between them. In this paper, we extend this approach to, firstly, best preserve the proximity between the adapted and the original documents by weighting the arcs of the conceptual neighborhood graphs and secondly, to deal with complex relations models by integrating the concept of the relations relaxation graphs that permit to handle the distances defined within the relations.**

***Index Terms*—multimedia document, spatial adaptation, conceptual neighborhood graph, distance relaxation**

I. Introduction

Multimedia document should be able to be played on different platforms (mobile phones, PDAs, laptops, PCs…) and must be presented according to the user preferences. The challenge is to execute and transmit to users media objects with a high quality in a consistent presentation that reproduces as closely as possible the semantics of the original document. Indeed, in the interactive online courses, the reader can use any type of devices without worrying whether the document is supported and the provided document shall reproduce the same content as specified by the author.

To deal with the diversification of target contexts and user preferences, multimedia document must to be adapted before being played, i.e., from the profile (hardware and software constraints and user preferences) and the source document, the adaptation must transform the document to be compatible with the target profiles.

A lot of works has been done in this way and showed that there are two types of adaptation. The first type is to specify directly the different organizations of the document for each target platform. In this case, the task becomes complex since it requires an extra work to the author when he should specify the conditions of execution of his document on each target context. It can also be incomplete since the author must foresee all the existing targets. The second type of adaptation is based on the dynamic adaptation of the document performed by a program transforming the document. In this type, two kinds of adaptation are possible: a local adaptation that considers the media object individually but does not most often, preserve the document semantics and the global adaptation related to the document composition (temporal, spatial and hypermedia specifications) and which preserves the semantics of the document [1].

This paper focuses on the latter type of the adaptation and concerns only the spatial aspect. It is devoted to the transgressive adaptation of the spatial relations where the document is represented by an abstract structure expressing all relations between media objects. In this context, adapt a multimedia document consists in transforming its abstract structure in a manner that it meets the requirements of the target profile.

In [1], it was shown that a spatial relation is represented by the combination of the Allen relations [2] on the horizontal and vertical axes and the spatial adaptation follows the same principle as the one defined for the temporal adaptation in [3]. This principle says that if no model of the original specification satisfies the adaptation constraints (context constraints) then transgressive adaptation is applied. In this approach, the transgressive adaptation consists in transforming the relations between media objects while ensuring two main properties: (i) the adaptation constraints are satisfied and (ii) the adapted document is, semantically, as close as possible to the initial document. This consists in finding another set of models (solutions), close to the initial, which satisfies these constraints. The proposed solution is to replace each relation that does not meet the profile by another semantically close. To find the closest relations, the conceptual neighborhood graph proposed in [4] is used.

doi:10.4304/jetwi.4.2.148-154

In this approach, the specification is done using models (temporal and spatial) where delays and distances between media objects are not considered, when actually, the produced documents (which are subjects of adaptation) are often, for expressiveness purpose, composed using very complex models.

In our previous works [5], we showed the interest of the weighted conceptual neighborhood graph usage when seeking for the closest substitution relations.

In this work, we will extend this approach to spatial models where distances between media objects are defined. To represent such spatial models, we use the temporal model of *Wahl* and *Rothermel* [6] which is an adaptation of the general model of Allen [2] where the authors proposed a set of composition operators integrating the delay concept in the relations. The elaboration of those operators was motivated by the need to facilitate the temporal specification of the document. More details about this representation are presented in section 4.

In the second section of this article, we present the context of our work. The third section presents multimedia adaptation approaches and in section 4, we present our approach to the spatial adaptation. In the fifth section we present the adaptation procedure and the last section concludes this paper.

II. Context of The Work

A multimedia document specification comprises temporal relations defining inter media objects synchronization and spatial relations that express the spatial representation of these media objects. The different users of multimedia documents impose different presentation constraints on the specification like display capabilities (screen size and resolution). The user's device may do not have the necessary capabilities to support the spatial constraints of the document.

For example, let us consider a multimedia document with the following spatial relation: *image B Above image A* and the resolution of the two images is 200 x 300. If the terminal resolution is superior or equal to 400 x 600 then, the user will not have any issue when displaying this document but, if its resolution is inferior to 400 x 600, we can have the following solutions [6]: (i) delete one of the two images or (ii) resize *image A* or *image B* or (iii) change the spatial relation *Above* by another relation.

The deletion of one of the two images may alter or produce an incomprehensible document. Resizing one of the objects will not affect the relation between them but may lead to a wrong interpretation or make the image indistinguishable in the case of an X-ray radio for example. The spatial relation modification does not cause information waste as in the image deletion and does not make indistinguishable the images. It only changes the places of those images.

Here, we focus on the relations transformation while trying to preserve the document semantic as well as possible.

Before we present the spatial adaptation of multimedia documents, we start by giving the different approaches for multimedia documents adaptation.

III. Adaptation Approaches

Several approaches have been proposed for the multimedia documents adaptation and we group them into four categories: the three categories, specification of alternatives, using transformation rules and using flexible documents models as presented in [1] to which we added the semantic and dynamic approaches.

Specification of alternatives: The author of the document specifies a set of presentation alternatives by defining criteria on some media objects of the document. If the media objects satisfy the criteria then, they are selected and presented else, they are deleted from the presentation. The adaptation is performed beforehand like in SMIL which defines the operator *switch* to specify the alternatives that are played only if they comply with the target profile. The advantage of this family is that the adaptation is instantly. However, the author has to foresee all the possible target profiles and specify all the conceivable alternatives.

Using Transformation rules: This category uses a set of transformation rules that are applied to the multimedia documents. The adaptation consists on selecting and applying rules to transform the document to satisfy the target profile. The advantage of this approach is that the author has not to care about the execution context of his document. Furthermore, this set of rules can be completed if new contexts appear. However, the entire transformation rules should be specified to ensure an efficient adaptation.

Using flexible documents models: The adapted document is generated automatically from a non-composed set of media objects represented by a model defining an abstraction of the document. Thanks to a formatting model, a multimedia presentation may be generated. In this category, we can mention Guypers [8] that aims to generate web-based presentation for multimedia databases. It is based on the use of semantic relations between multimedia objects and ontologies.

Semantic and dynamic approaches: In [1], an approach based on the qualitative specifications of the document was proposed. Each document is considered as a set of potential executions and each profile is considered as a set of possible executions. The adaptation is done according to the context at the execution time. It consists on calculating the intersection between the potential (initial specification models) and the possible executions corresponding to the target profile. The advantage of this approach is its independence from description languages. However, the usage of the conceptual neighborhood graphs where all the weights of the arcs are set to one (01) assumes that a relation may be replaced by any one of its immediate neighbors while there are substantial differences between them; especially when using more elaborated relations models. Furthermore, the delays and the distances defined within the relations are not considered.

In the reminder of this paper, we present our proposition for the spatial adaptation which fits into this last category.

IV. SPATIAL ADAPTATION

A. *Context Description* [9]

To describe the target context (profile), the universal profiling schema (UPS) [10] can be used. It is defined to serve as a universal model that provides a detailed description framework for different contexts. UPS is built on top of CC/PP and RDF [11]. Unlike CC/PP, UPS does not describe only the context of the client but it describes also all the entities that exist in the client environment and that can play a role in the adaptation chain from the content server to the target client.

UPS includes six schemas: the client profile schema, the client resources profile, the document instance profile, the adaptation method profile and the network profile. The description of the user is included in the client profile schema.

B. *Spatial Relations Model*

To describe the spatial presentation of a multimedia document, we use the directional representation [12] that permits to define the orientation in space between media objects.

In this representation, a media object is considered as two intervals corresponding to its projection on the horizontal and vertical axes. The set of the directional relations is obtained by combining the intervals of the two media objects on the two axes by using the *Wahl* and *Rothermel* relations model [6] presented in figure 1, on each axis.

There are 20 possible relations (10 basic relations and theirs inverses) on each axis. Thus, a spatial relation is represented by two temporal relations [1]: one on the horizontal axis and one on the vertical axis. For example, the spatial relation *left_top* can be represented by its two components: *before* (on the horizontal axis) and *before* (on the vertical axis).

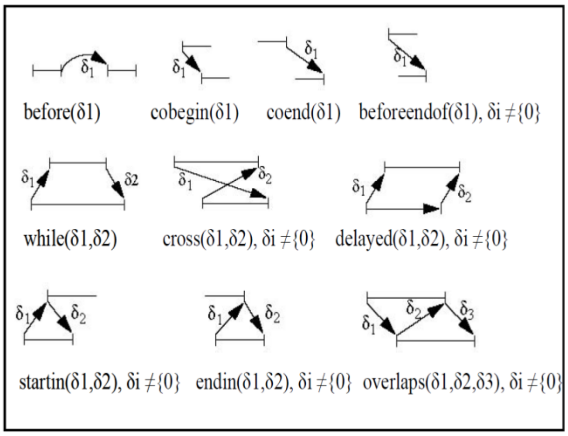

Figure 1. The relations model of Wahl and Rothermel [6]

In the multimedia document spatial adaptation, we follow the same procedure as the one presented in [5] for the temporal adaptation.

C. *Conceptual Neighborhood Graph of the Spatial Relations*

The representation of the spatial relations by two components (temporal relations) permits us to use the conceptual neighborhood graph of the temporal relations [4] to elaborate the spatial relations conceptual neighborhood graph. Indeed, for each component of the spatial relations (vertical and horizontal components), we use the temporal relations conceptual neighbourhood graph. The composition of the two graphs gives the conceptual neighborhood graph of the spatial relations. It's the square product of the conceptual neighborhood graph of temporal relations.

Conceptual Neighborhood

Two relations between two media objects are *conceptual neighbors* if they can be directly transformed into one another by continuous deformation (shortening or lengthening) of the duration of the media objects without going through an intermediate relation.

For example, in figure 2, the relations *before* and *Overlaps* are conceptual neighbors since a temporal extension of the media object *A* may cause a direct transition from the relation *before* to the relation *Overlaps.* And in figure 3, the relations *before* and *Contains* are not conceptual neighbors, since a transition between those relations must go through one of the relations *Overlaps*, *Endin*, *Cobegin*, *Coend*, *Beforeendof*$^{-1}$, *Cross*$^{-1}$, *Delayed*$^{-1}$ or *Startin*$^{-1}$.

The Conceptual neighborhood graph, presented in figure 4, is defined as a graph where the nodes correspond to the relations of *Wahl* and *Rothermel* model and each arc between two nodes (relations) ***r*** and ***r'*** corresponds to the satisfaction of the propriety of the conceptual neighborhood, i.e., ***r*** and ***r'*** are conceptual neighbors.

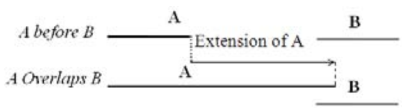

Figure 2. Example of neighboring relations.

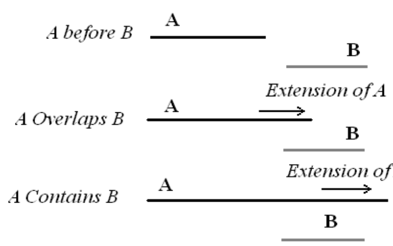

Figure 3. Example of non-neighboring relations

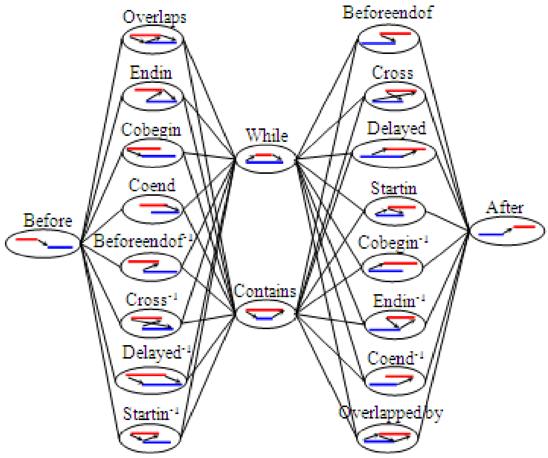

Figure 4. Conceptual neighborhood graph of the Wahl and Rothermel relations

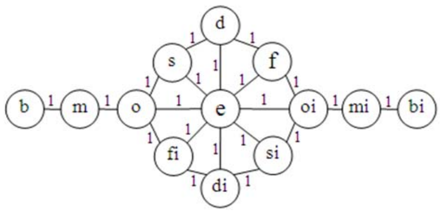

Figure 5. Conceptual neighborhood graph of Allen relations

Weighting of the Conceptual Neighborhood Graph

In the conceptual neighborhood graph of the relations of Allen [2] (figure 5) presented in [3], the weights of the arcs are set to 1. This assumes that a relation can be indifferently replaced by any one of its neighbors having the same smallest conceptual distance whereas there may be a substantial difference between the candidate relations. It would be interesting to differentiate the proximity degree between these relations. The distinction in the proximity of the neighboring relations is done by assigning different weights to the arcs of a graph.To assign different weights to the arcs of a conceptual neighborhood graph, our idea is to identify all the information items that characterize a temporal relation so they serve as a basis for comparing and differentiate the similarity between the relations.

Information Items of a Relation

The analysis of a relation between two media *A* and *B* (Figure 6) on a time axis showed that the positioning is done according to the order that exists between their respective edges (occurrence order of the beginning and ending instants of the media objects). Therefore, to characterize a temporal relation, we selected the following information items: the values of the beginnings and the endings of the media objects and the orders (precedes (>) or succeeds (<)) between their edges.

Table1 gives a recapitulation of the selected information items. Then, we have for each relation, determined the information items that it contains among the selected ones and the result is given in Table 2.

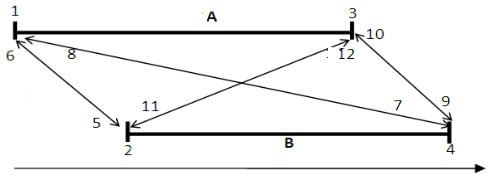

Figure 6. Information items of a relation

TABLE I.
INFORMATION ITEMS THAT CHARACTERIZE A TEMPORAL RELATION

Information	**1**	**2**	**3**	**4**	**5**	**6**
Signification	begin(A)	begin(B)	end(A)	end(B)	1>2	1<2
Information	**7**	**8**	**9**	**10**	**11**	**12**
Signification	1>4	1<4	3>4	3<4	3>2	3<2

TABLE II.
INFORMATION ITEMS CONTAINED IN THE WAHL AND ROTHERMEL RELATIONS

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Before	0	1	1	0	0	1	0	1	0	1	0	1
Overlaps	1	1	1	1	0	1	0	1	0	1	1	0
Endin	0	1	1	1	0	1	0	1	0	1	1	0
Cobegin	1	1	0	0	0	1	0	1	0	1	1	0
Coend	0	0	1	1	0	1	0	1	0	1	1	0
Beforeendof^{-1}	0	1	1	0	0	1	0	1	0	1	1	0
Cross^{-1}	1	1	1	1	0	1	0	1	0	1	1	0
Delayed^{-1}	1	1	1	1	0	1	0	1	0	1	1	0
Startin^{-1}	1	1	1	0	0	1	0	1	0	1	1	0
While	1	1	1	1	1	0	0	1	0	1	1	0
Contains	1	1	1	1	0	1	0	1	1	0	1	0
Beforeendof	1	0	0	1	1	0	0	1	1	0	1	0
Cross	1	1	1	1	1	0	0	1	1	0	1	0
Delayed	1	1	1	1	1	0	0	1	1	0	1	0
Startin	1	1	0	1	1	0	0	1	1	0	1	0
Cobegin^{-1}	1	1	0	0	1	0	0	1	1	0	1	0
Endin^{-1}	1	0	1	1	1	0	0	1	1	0	1	0
Coend^{-1}	0	0	1	1	1	0	0	1	1	0	1	0
Overlaps^{-1}	1	1	1	1	1	0	0	1	1	0	1	0
Before^{-1}	1	0	0	1	1	0	1	0	1	0	1	0

Calculation of the Similarity Degree Between a Relation and its Immediate Neighbors

To calculate the similarity degree between a relation and its neighbors, a distance should be defined. The aims of this distance is to make the difference of proximity between the relations but not to have a precision. Thus, any distance definition can be used (Euclidian distance, Manhattan distance, etc). We choose the *Manhattan distance* defined as follows:

Let us consider the two vectors V (v_1, v_2... v_n) and U (u_1, u_2... u_n). The Manhattan distance between V and U is:

$$d_{(V\text{-}U)} = \Sigma^{n}_{i=1} |v_i - u_i|$$

In our work, we consider the information items of each relation as a vector where the value of each information item is set to 1 whether this information item is included in the relation or zero (0) otherwise.

Using the Manhattan distance, we established the distances between each relation and its immediate neighbors as presented in table 3. Then, we affect the calculated distances to the arcs of the conceptual neighborhood graph as shown in figure 7.

TABLE III.
DISTANCES BETWEEN THE RELATIONS AND THEIRS NEIGHBORS

	b	o	e	cb	ce	beo^{-1}	c^{-1}	d^{-1}	s^{-1}	w	cn	beo	c	d	s	cb^{-1}	e^{-1}	ce^{-1}	o^{-1}	b^{-1}
b	-	4	3	4	4	2	4	4	3	-	-	-	-	-	-	-	-	-	-	-
o	4	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
ei	3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-
cb	4	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	-
ce	4	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	-
beo^{-1}	2	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	-
c^{-1}	4	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
d^{-1}	4	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	-
si^{-1}	3	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	-
w	-	2	3	4	4	4	2	2	3	-	-	4	2	2	3	4	3	4	2	-
cn	-	2	3	4	4	4	2	2	3	-	-	4	2	2	3	4	3	4	2	-
beo	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	2
c	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	4
d	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	4
si	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	3
cb^{-1}	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	4
ei^{-1}	-	-	-	-	-	-	-	-	-	3	3	-	-	-	-	-	-	-	-	3
ce^{-1}	-	-	-	-	-	-	-	-	-	4	4	-	-	-	-	-	-	-	-	4
o^{-1}	-	-	-	-	-	-	-	-	-	2	2	-	-	-	-	-	-	-	-	4
b^{-1}	-	-	-	-	-	-	-	-	-	-	-	2	4	4	3	4	3	4	4	-

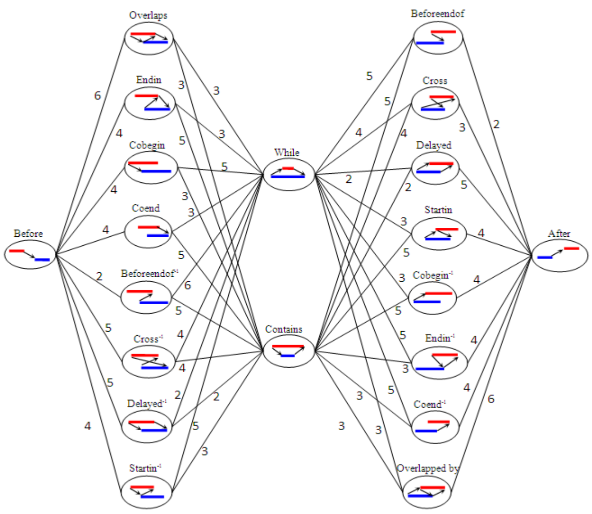

Figure 7. Weighted conceptual neighborhood graph of Wahl and Rothermel relations

The Conceptual Distance of a Spatial Relation

The conceptual distance [1] between two relations ***r*** and ***r'*** is the length of the shortest path between those relation in the conceptual neighborhood graph.

The conceptual distance of a spatial relation is defined as the sum of the conceptual distances of its two components (temporal relations on the two axes). For example, let's consider the two spatial relations r_1=<Before, Overlaps> and r_2=<Endin, While>. The conceptual distance between r_1 and r_2 is $d_x(r_1, r_2) + d_y(r_1, r_2)$ i.e, d (Before, Endin) + d (Overlaps, While).

C. Distance Relaxation

According to the consideration of a spatial relation as two temporal relations, its distances are taken as delays in the two temporal relations. In this case, before seeking for substitution relation, we start by trying to relax these delays in order to keep the relations and give us the opportunity to best preserve the semantic of the initial document.

For example, the relation *A Before (d) B* can be transformed into the relation *A Before (-) B* where the symbol "-" means that the distance is not specified.

We present below, the delays relaxation of the relations of the *Wahl* and *Rothermel* model. For this, we use a graph structure (we call it relaxation graph) based on the number of delays defined for a relation as shown in figure 8. The relaxation graph of a relation is composed by the different forms of this relation obtained by a progressive relaxation of its delays.

To illustrate this principle, consider the example of the figure 9 where the specified relation is

Image *<Overlaps (200,50,250>, Contains (10, 90)> Text*

And the target screen size is *480 x 360*.

The two objects cannot be displayed because the width of the area they occupy (500 px) is larger than the screen width (480 px). The distances relaxation of this relation can lead to an adaptation solution without changing the relation and this solution (see figure 10) may be:

Image *<Overlaps (180, 70, 230>, Contains (10, 90)> Text.*

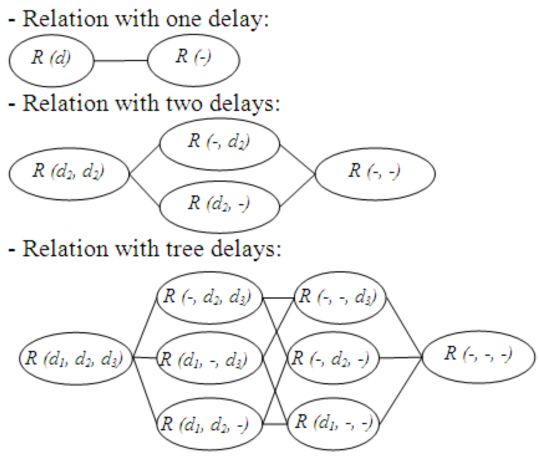

Figure 8. Delays relaxation graphs

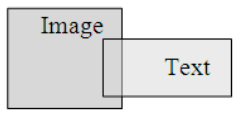

Figure 9. Example of a spatial specification

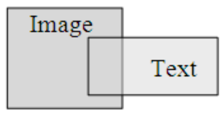

Figure 10. An adaptation solution with distance relaxation

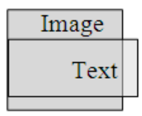

Figure 11. An adaptation solution without distance relaxation

If we proceeded directly by replacing the relation as was proposed in [1] then, the relation *Overlaps* will be directly replaced by the relation *While* and we will get the result of the figure 11.

V. Adaptation Procedure

The semantic adaptation of a multimedia document is achieved by modifying the specification of the document. This involves finding another set of values for the distances of the relations or otherwise a set of relations satisfying the adaptation constraints of the target platform with the smallest distance from the initial specification.

The distances relaxation and the relations replacement processes are done by traversing the graphs (relaxation graph for distances relaxation and conceptual neighborhood graph for the relations replacement) in both directions. This is done by searching the shortest path between the relation to be replaced and the other relations of the graph. A relation is considered as candidate to replace the initial only if it does not lead to an inconsistency (for this we recommend the use of the Cassowary resolver [13]). Finally, the solution with the smallest conceptual distance is considered as the adapted document.

The adaptation procedure is done by following two phases: Distances relaxation and transgressive adaptation.

A. Adaptation Algorithm

We implemented this procedure throw an algorithm as shown in algorithm 1.

```
// Phase 1: relaxation

Input : MIij: //Matrix of the document relations
// relaxation relations search
for i = 0 to n-1 do    // n number of objects
   for j = 0 to n-1 do
      RG = SelectRG(MI[i, j]);
      MS[i, j] = determineRelaxedRelations(RG);
   end for
end for

// Elaboration of the possible combinations
//output : combinations list Cp
Cp = ElaborateCombinationsMatrix(MSij);
// Sort combinations according to the conceptual distance
for i=0 to nCombinations -1 do
   d[i] ← 0;                      // Matrix of the conceptual distances
   for j=0 to n-1 do
      d[i] = d[i] + Djikstra(C[i,j], MR[i,j]);
   end for
end for
QuickSortCombinations(C[i], d[i]);

// Consistency Verification
found ← false ;
for i = 0 to nCombinations -1 do
   if Consistency (C[i]) then
      Solution ← (C[i]);
      Exit();
   end if
end for

// Phase 2: replacement

// replacement relations search
Clear (MSi, j);
for i = 0 to n-1 do    // n number of objects
   for j = 0 to n-1 do
      for k=1 to NR do   // NR : number of the relations of the model
         if respecteProfile (Rm [k]) then  //Rm set of the model relations
            MS [i, j] ← MS [i, j] ∪ {Rm [k]};
         end if
      end for
   end for
end for
// Elaboration of the possible combinations
//output : combinations list Cp
Cp = ElaborateCombinationsMatrix(MSij);

// Sort combinations according to the conceptual distance
for i=0 to nCombinations -1 do
   d[i] ← 0;                      // Matrix of the conceptual distances
   for j=0 to n-1 do
      d[i] = d[i] + Djikstra(C[i,j], MR[i,j]);
   end for
end for
QuickSortCombinations(C[i], d[i]);

// Consistency Verification
found ← false ;
for i = 0 to nCombinations -1 do
   if Consistency (C[i]) then
      Solution ← (C[i]);
      Exit();
   end if
end for
```

Algorithm 1. Adaptation algorithm

- *RG* : relaxation graph of the selected relation MI[i, j]
- *determineRelaxedRelations(RG) :* determines all the relations forms obtained by relaxing the initial relation by using the correspondent Relaxation graph GR.
- *ElaborateCombinationsMatrix(MSij):* determines all the possible combinations of the candidate relations for the replacement of the initial relations of the document.
- *Consistency (C[i]):* Calls the linear constraints solver: Cassowary for the consistency verification of the solution.

B. Algorithm Description

Distance Relaxation

The algorithm takes as input the matrix MI_{ij}: matrix of the complete relations graph of the initial specification. For each relation of MI_{ij}, we identify its corresponding RG from which we determine all the different form of this relation obtained by the relaxation process (only the relations that comply with the target profile are retained). The result is placed in the substitution matrix MS_{ij}. Then, we determine, by combinations, all the possible solutions C_i from the matrix MS_{ij}. Next, we perform an ascending sort of all solutions of C_i with the classical sorting algorithm "*quick sort*" using the conceptual distances calculated by using the *Dijkstra's* shortest path *algorithm* in the GR of each relation. This will ensure that the solutions are sorted from the closest specification to the farthest from the original. Finally, we call the constraints solver (cassowary [13]) for the consistency verification and the calculation of the solution (new values to the distances) for each specification in the order defined by the sort. The first meet with a consistent solution stops the process and that solution is considered as the adapted document.

Relations replacement

If at the end of the distances relaxation phase, no solution was found, we perform the replacement of the relations:

We take back the initial relation matrix MI_{ij} and we determine the substitution matrix MS_{ij}, which gives for each relation of the matrix M_{ij} the relations candidates for its substitution (not its relaxation as in the first phase) from those that meet the target profile constraints among the relations of the model, we determine by combinations, all the possible solutions C_i from the matrix MS_{ij}. Next, we perform an ascending sort of all solutions of C_i using the conceptual distances calculated by using the *Dijkstra's* shortest path *algorithm* through the conceptual neighborhood graph. Finally, we call the constraints solver cassowary for the consistency verification and the calculation of the solution for each specification. The first verification that gives a consistency stops the process of solutions consistency verification.

VI. CONCLUSION

In this paper, we proposed an approach to the spatial adaptation of multimedia documents that takes into account the distances defined in the relations.

The differentiation in similarity degrees between each relation and its neighbors by affecting different weights to the arcs of the conceptual neighborhood and the introduction of the relaxation principle to take into consideration the distances permit to replace a relation with its closest semantically and thus to keep the document as close as possible to the original document.

The first axe of our future work would be to merge the two phases of the adaptation procedure by integrating the RGs of the relations in the conceptual neighborhood graph and then, have only one phase that will permit to have an adaptation solution composed by relaxed and replaced relations.

The second axe would be to determine the similitude measure between the adapted document and the original one by using some extra information (annotations) like weights assigned to relations based on their importance in the specification to determine relations to be modified or to be removed if it's necessary.

REFERENCES

[1]. S. Laborie. Adaptation sémantique de document multimédia. *PhD Thesis*, University of Joseph Fourier - Grenoble 1, France, 2008.

[2]. J. F. Allen. Maintaining knowledge about temporal intervals. *Communication of the ACM*, vol. 26 (1), 1983, pp. 832–843

[3]. J. Euzenat, N. Layaïda, V. Diaz. A semantic framework for multimedia document adaptation. *18th International Joint Conference on Artificial Intelligence (IJCAI)*. Acapulco (MX), 2003, pp. 31-36.

[4]. C. Freksa. Conceptual neighborhood and its role in temporal and spatial reasoning. In *Proceedings of the IMACS International Workshop on Decision Support Systems and Qualitative Reasoning*. Toulouse, France, 1991, pp. 181-187.

[5]. A. Maredj, N. Tonkin. Weighting of the conceptual neighborhood graph for multimedia documents temporal adaptation. *Proc. Of the International Arab Conference on Information technology (ACIT'2010).* Benghazi-Libya, 2010, pp 98.

[6]. T. Wahl, K. Rothermel. Representing Time in Multimedia Systems. *In Proceedings of the International Conference on Multimedia Computing and Systems*. Boston, Massachusetts. 1994, pp. 538-543.

[7]. A. Gomaa, N. Adam, V. Atluri. Adapting Spatial Constraints of Composite Multimedia Objects to achieve Universal Access. *IEEE International Workshop on Multimedia Systems and Networking (WMSN05), held in conjunction with the 24th IEEE International Performance, Computing, and Communications Conference (IPCCC)*. Phoenix, Arizona, USA, April 2005.

[8]. J. Geurts, J. V. Ossenbruggen and L. Hardman: Application specific constraints for multimedia presentation generation. *In Proceedings of the International Conference on Multimedia Modeling*, 2001, pp. 247-266.

[9]. T. Lemlouma , N. Layaïda context-aware adaptation for mobile devices (2004) *in proceedings of the IEEE international conference on mobile data management*. Berkeley, CA, USA, 2004, pp.19-22,

[10]. . Lemlouma , N. Layaïda, Universal Profiling for Content Negotiation and Adaptation in Heterogeneous Environments, *W3C Workshop on Delivery Context*, W3C INRIA Sophia-Antipolis, France, 4-5 March 2002.

[11]. Graham Klyne et al, Composite Capability/Preference Profiles (CC/PP): Structure and Vocabularies, http://www.w3.org/TR/CCPP-structvocab/, W3C Working Draft, 15 March 2001

[12]. D. Papadias, T. Sellis. Qualitative Representation of Spatial Knowledge in Two-Dimensional Space. *Special Issue on Spatial Databases*, Vol. 3(4), 1994, pp. 479-516.

[13]. J. Badros, A. Borning, S. J. Stuckey. The Cassowary linear arithmetic constraint solving algorithm. *ACM Transactions on Computer-Human Interaction (TOCHI)*, vol. 8(4), 2001, pp. 267–306.

Azze-Eddine Maredj acquired his doctorate in computer science at the university of science and technology Houari Boumediane (Algeria). He is a search scientist at the Research Center on Scientific and Technical Information (CERIST), algiers (Algeria) where he lead the "multimedia system and structured documents" team. His Research interests are mutlimedia authoring systems and retrieval systems of structured and multimedia documents. Currently, he works on project devoted to delever an authoring system which permits the edition, the rendering and the exploitation (indexation and retreival) of mutlimedia documents.

Nourredine Tonkin received the engineer degree in computer science, from the Mouloud Mammeri University, Tizi-Ouzou (Algeria) in 2004. He Works at the Research Center on Scientific and Technical Information (CERIST), Algeria. His Research interests are mutlimedia authoring systems. Currently, he works on the adaptation of multimedia documents.