

# Micromégas

Approches multi-échelles pour la navigation  
dans les masses de données familières



Site web

<http://insitu.lri.fr/micromegas/>

Site wiki

<http://wiki.lri.fr/micromegas/>

Alias email

[micromegas@lri.fr](mailto:micromegas@lri.fr)

# Equipe pluridisciplinaire

## **Projet Commun In Situ - LRI et INRIA Futurs**

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

Matthieu Langet, ingénieur Micromégas (2004-6)

## **LMP Marseille**

Yves Guiard, coordinateur

## **Projet commun MErLin - INRIA Rocquencourt et LORIA**

Noëlle Carbonell

Suzanne Kiefer

Dominique Scapin

Charles Tison

## **Pôle informatique Institut Pasteur**

Olivier Amanatian

Catherine Letondal

Lina Tanguy

# Equipe pluridisciplinaire informaticiens (IHM)

## **Projet Commun In Situ - LRI et INRIA Futurs**

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

Matthieu Langet

LMP Marseille

Yves Guiard, coordinateur

## **Projet commun MErLIIn - INRIA Rocquencourt et LORIA**

Noëlle Carbonell

Suzanne Kiefer

Dominique Scapin

Charles Tison

## **Pôle informatique Institut Pasteur**

Olivier Amanatian

Catherine Letondal

Lina Tanguy

# Equipe pluridisciplinaire

# Ergonomes

## Projet Commun In Situ - LRI et INRIA Futurs

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

Matthieu Langet, ingénieur Micromégas (2004-6)

## LMP Marseille

Yves Guiard, coordinateur

## Projet commun MErLin - INRIA Rocquencourt et LORIA

Noëlle Carbonell

Suzanne Kiefer

Dominique Scapin

Charles Tison

## Pôle informatique Institut Pasteur

Olivier Amanatian

Catherine Letondal

Lina Tanguy

# Equipe pluridisciplinaire psychologues

## **Projet Commun In Situ - LRI et INRIA Futurs**

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

Matthieu Langet, ingénieur Micromégas (2004-6)

## **LMP Marseille**

Yves Guiard, coordinateur

## **Projet commun MErLIn - INRIA Rocquencourt et LORIA**

Noëlle Carbonell

Suzanne Kiefer

Dominique Scapin

Charles Tison

## **Pôle informatique Institut Pasteur**

Olivier Amanatian

Catherine Letondal

Lina Tanguy

# Equipe pluridisciplinaire biologistes

## Projet Commun In Situ - LRI et INRIA Futurs

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

Matthieu Langet, ingénieur Micromégas (2004-6)

## LMP Marseille

Yves Guiard, coordinateur

## Projet commun MErLIn - INRIA Rocquencourt et LORIA

Noëlle Carbonell

Suzanne Kiefer

Dominique Scapin

Charles Tison

## Pôle informatique Institut Pasteur

Olivier Amanatian

Catherine Letondal

Lina Tanguy

# Deux recrutements facilités par l'ACI MD

## Projet Commun In Situ - LRI et INRIA Futurs

Michel Beaudouin-Lafon

Olivier Chapuis

**Yangzhou Du** post-doc Micromégas (2004-5)

Jean-Daniel Fekete

Wendy Mackay

Nicolas Roussel

**Matthieu Langet** ingénieur Micromégas (2003-5)

**LMP Marseille**

Yves Guiard, resp.

## Projet commun MErLIn - INRIA Rocquencourt et LORIA

Noëlle Carbonell

*Suzanne Kiefer*

Dominique Scapin

*Charles Tison*

## Pôle informatique Institut Pasteur

*Olivier Amanatian*

Catherine Letondal

# Navigation multi-échelle

- *Un fossé qui se creuse depuis 20 ans*
  - Progression exponentielle de la taille des mondes électroniques
  - La taille de nos vues sur ces mondes et les capacités cognitives humaines sont des constantes

- *Dilemme macro-micro*  
Complétude ou résolution

- Visualisation et navigation *multi-échelle*

# Données familières

Définition informelle

"ce que je sauvegarde ou souhaiterais sauvegarder"

"ce qui différencie *ma* machine des autres machines"

Données de nature personnelle ou professionnelle

Créées par l'utilisateur (ex : courriers envoyés)

Collectées par l'utilisateur (ex : courriers reçus)

Produites pour lui par le système (ex : fichiers de configuration)

# Recherche et navigation actives dans ces masses de données

## Trois cas de figure

1. Recherche d'un élément inconnu: l'élément existe-t-il quelque part?
2. Recherche d'un élément connu dont la localisation est incertaine
3. Navigation vers un élément *connu et bien localisé*
  - Avec des Go de données personnelles, aller chercher l'élément en question là où il est prend du temps!
  - Activité cognitivement utile, complément indispensable aux procédures de recherche automatique (Finder, etc.)

# PLAN

## **Etudes des activités de l'utilisateur**

1. Enregistrement automatique et visualisation des activités
2. Enregistrement des mouvements d'exploration oculaires
3. Etudes de cas

## **Conception, développement et évaluation d'interfaces**

4. Visualisation perspective

# ACTIVITES UTILISATEUR

## *1. Enregistrement automatique et visualisation différée des activités de l'utilisateur*

**Projet Commun In Situ** - LRI et INRIA Futurs

Olivier Chapuis

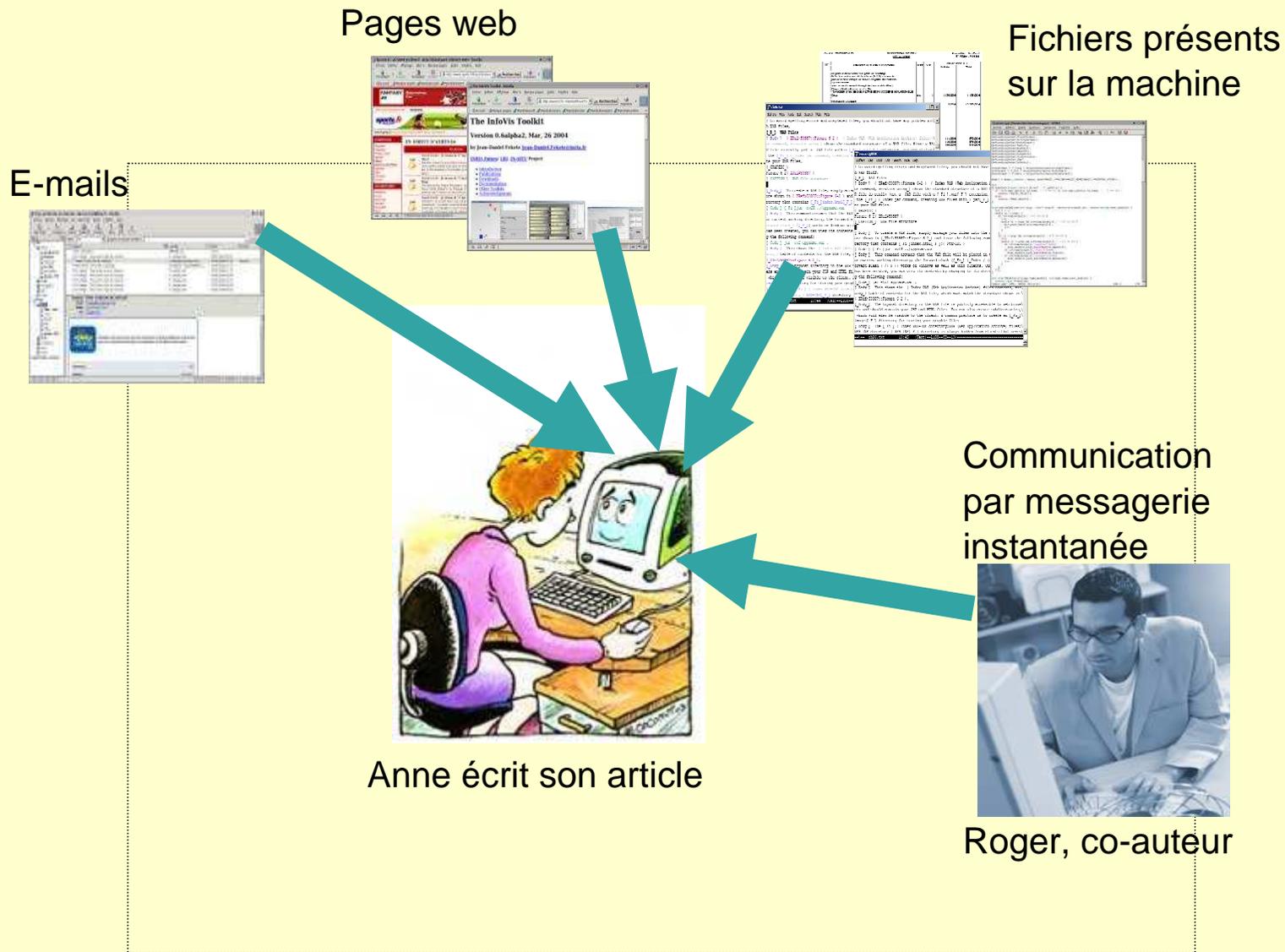
Jean-Daniel Fekete

Matthieu Langet

Nicolas Roussel

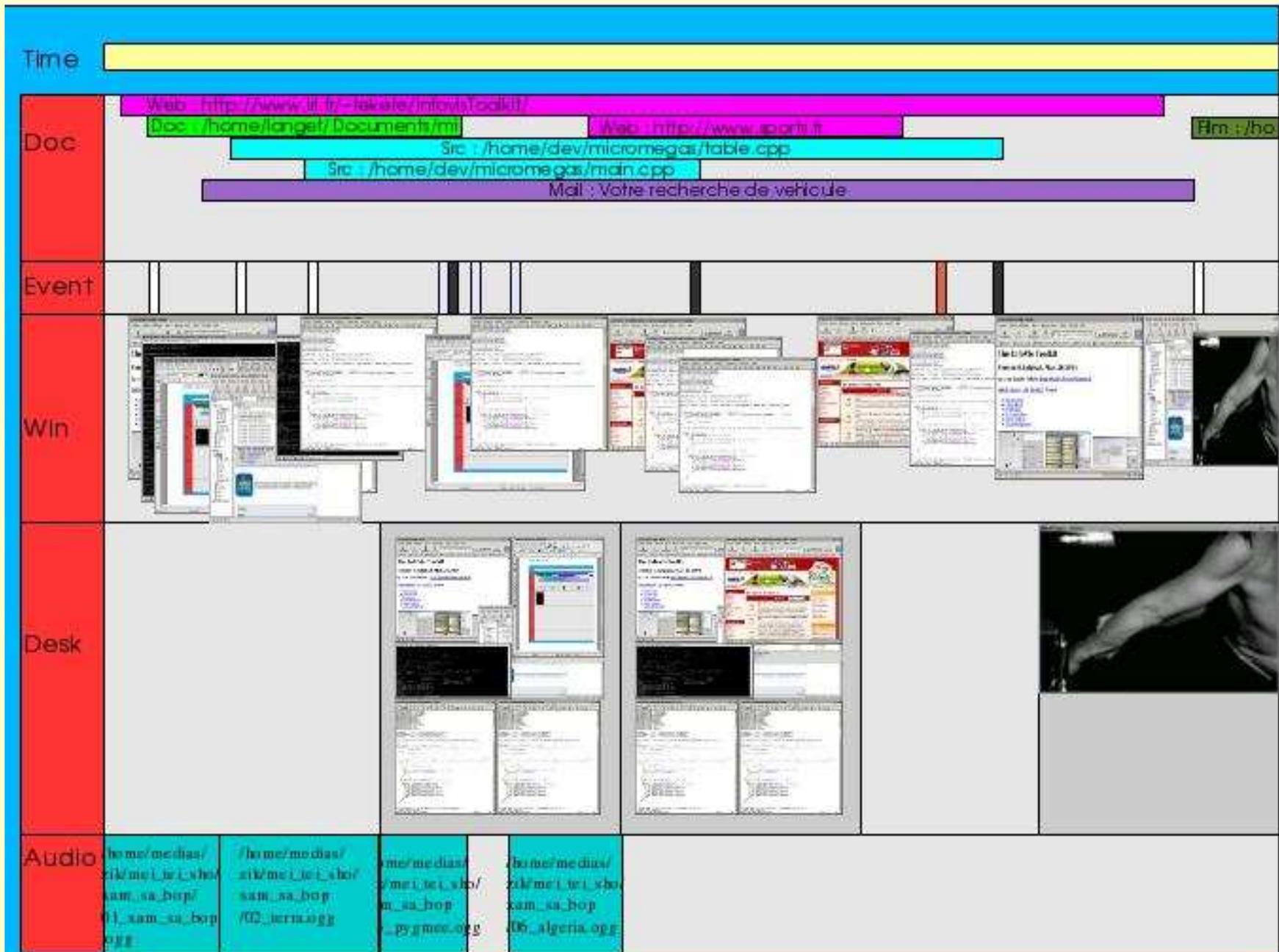
Développer un outil pour l'enregistrement automatique en temps réel et la visualisation, à un haut niveau d'abstraction, des activités de l'utilisateur

# Un scénario possible : la rédaction d'un article

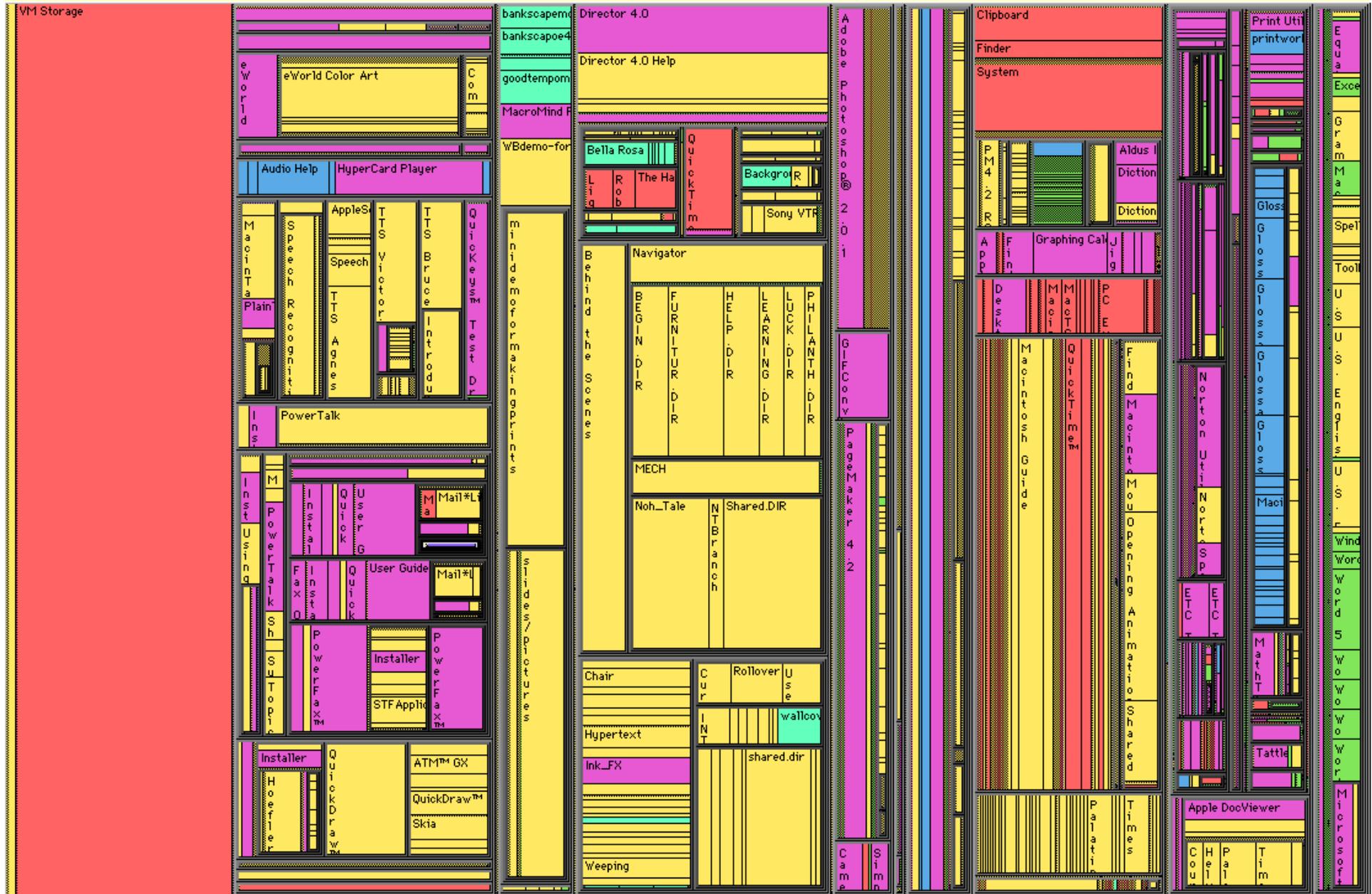


Il existe un lien entre toutes ces données : la rédaction de l'article.

# Visualisation de type *LifeLine*

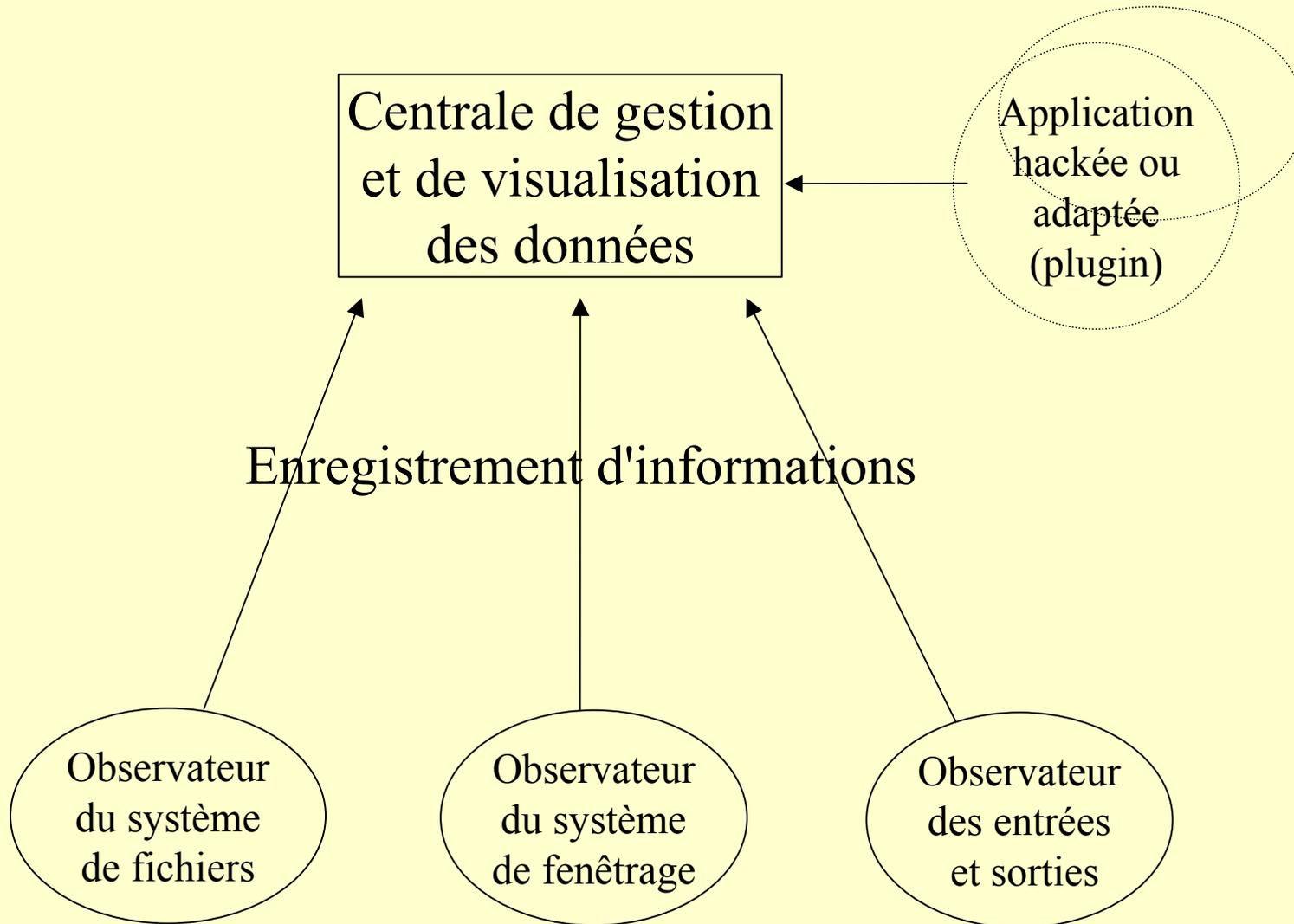


# Treemap (Jean-Daniel Fekete)



Name	Size	% Total	Type	Creator	Creation Date	Modification Date
Path Information						
Unknown	Text	Graphics	Archives/Stacks	Programming	Applications	System

# Architecture du système d'observation et de stockage des données



# ACTIVITES UTILISATEUR

## *2. Enregistrement des mouvements d'exploration oculaires*

**Projet commun MErLIn - INRIA Rocquencourt et LORIA**

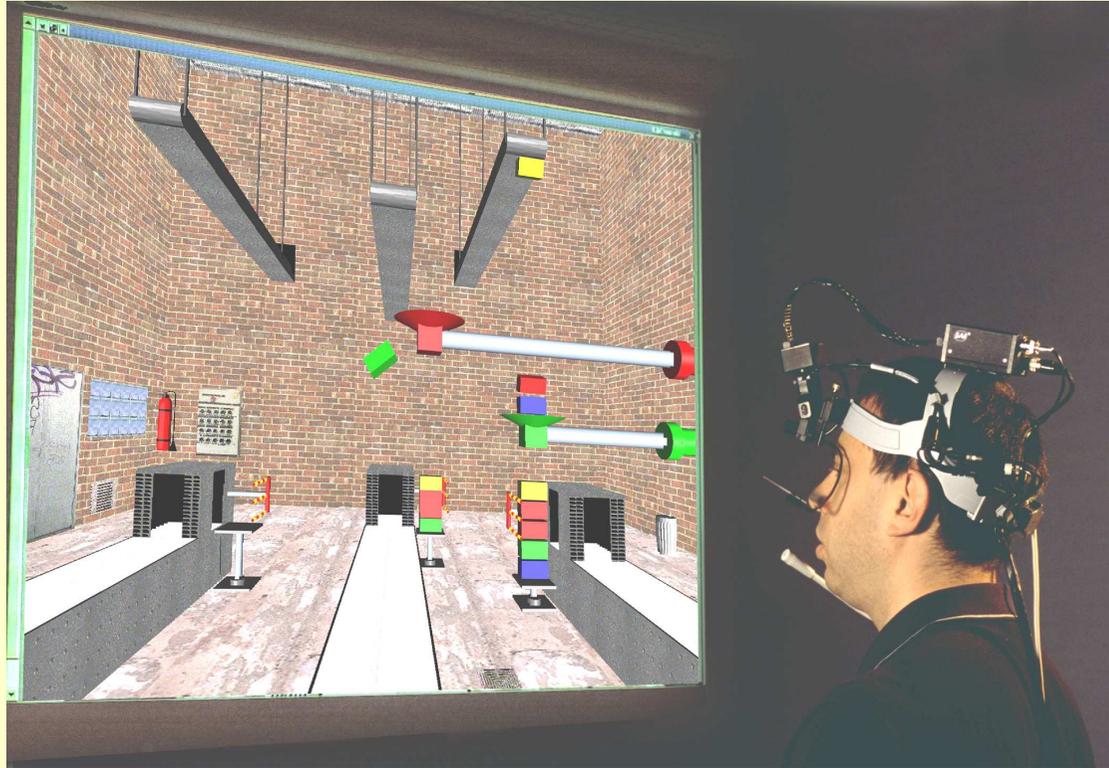
Noëlle Carbonell

Suzanne Kiefer

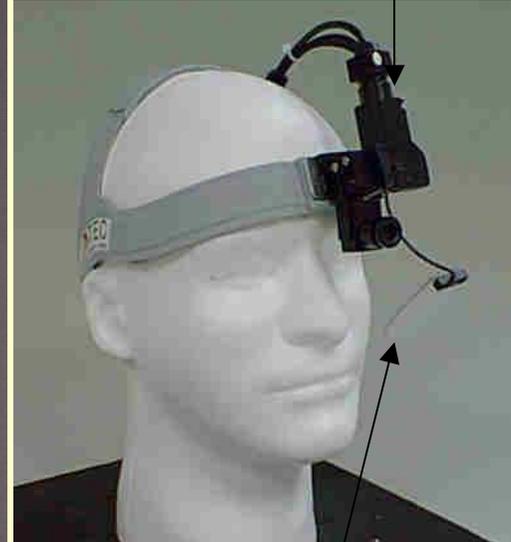
Dominique Scapin

Charles Tison

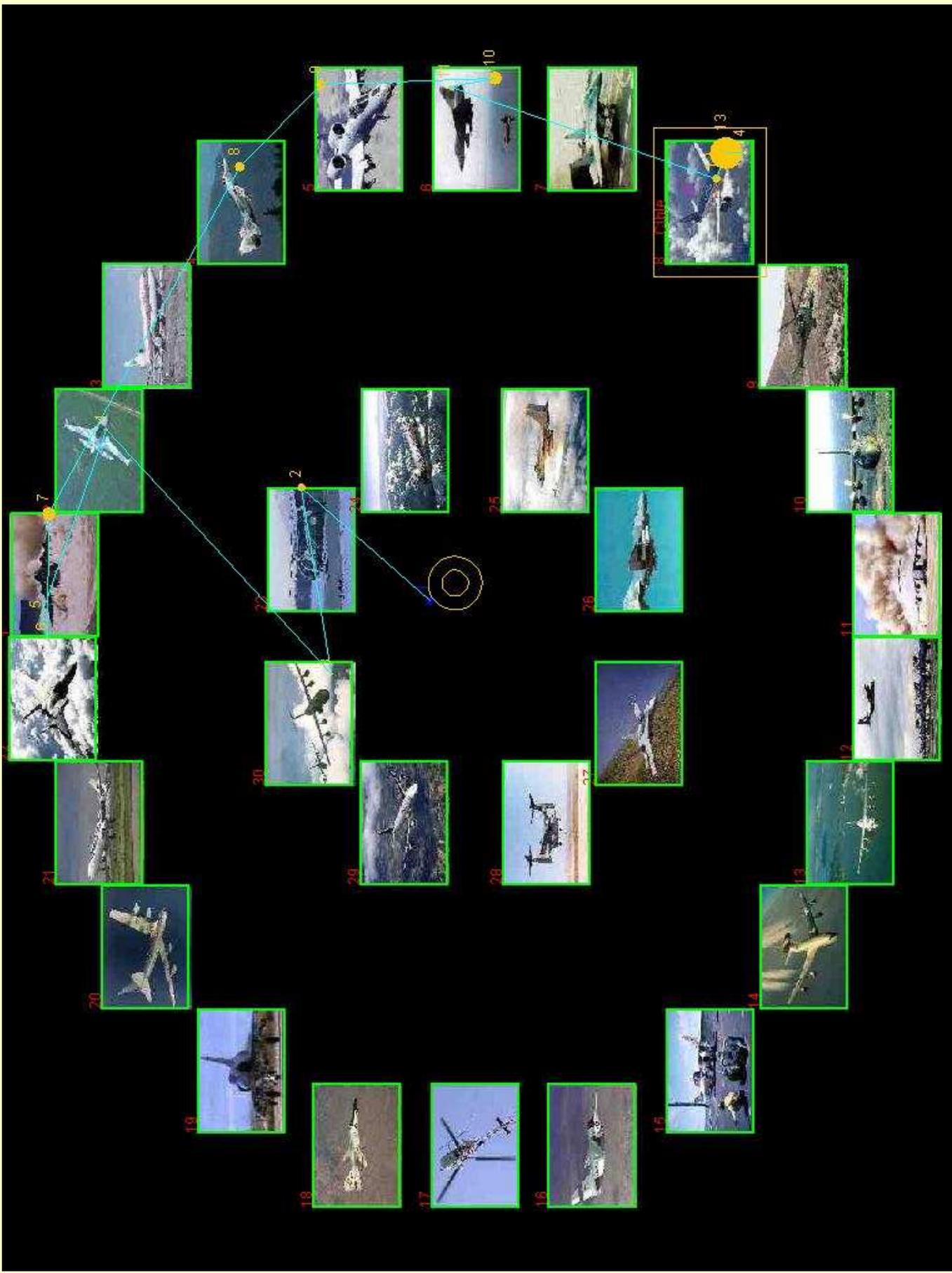
Evaluation ergonomique de visualisations  
interactives de collections non structurées d'objets  
graphiques 2D familiers  
(e.g., photos)



Caméra infrarouge



Miroir translucide



# ACTIVITES UTILISATEUR

## *3. Etudes de cas*

**Projet Commun In Situ - LRI et INRIA Futurs**

Wendy Mackay

**Pôle informatique Institut Pasteur**

Olivier Amanatian

Catherine Letondal

Lina Tanguy

### Interviews

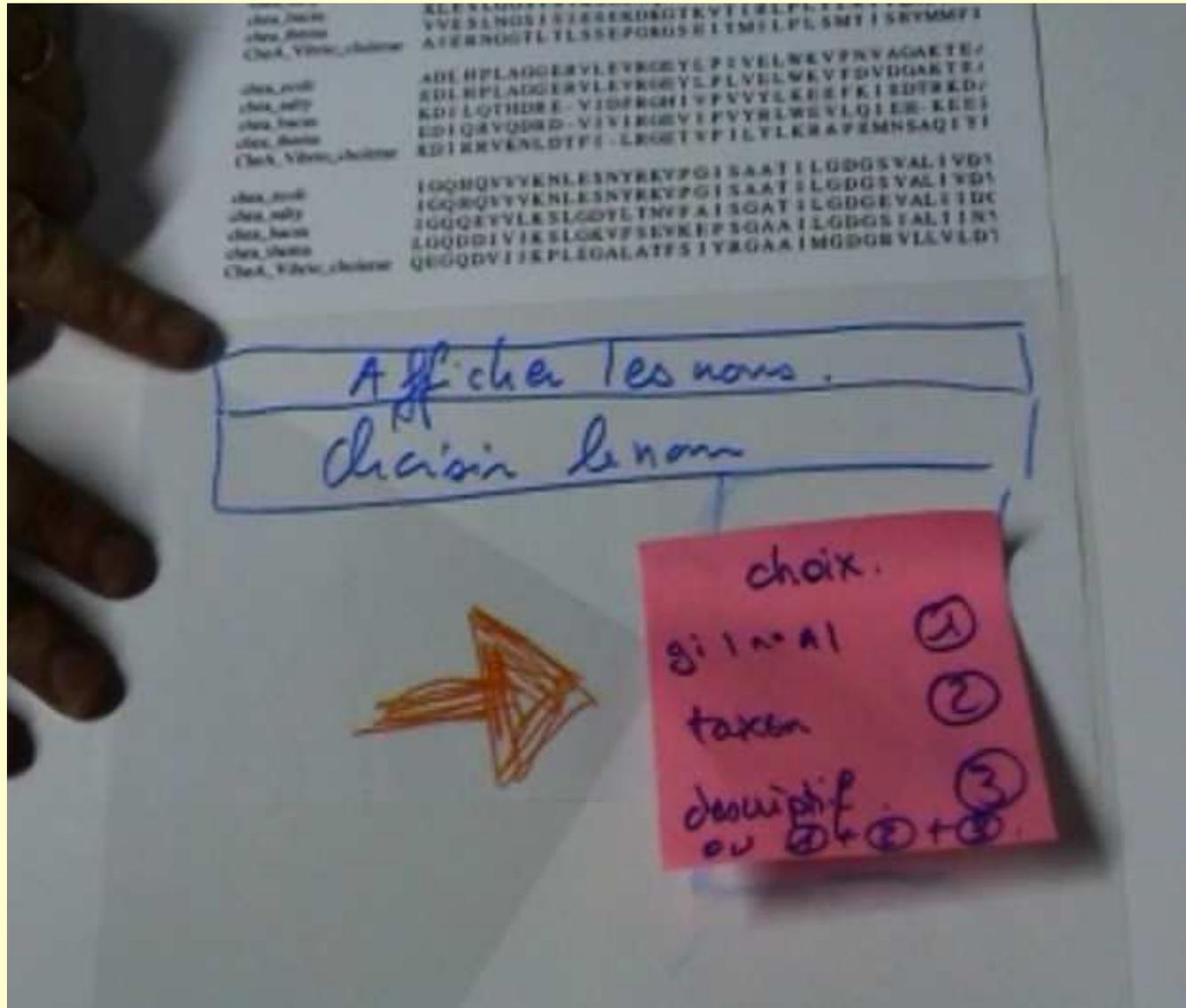
chercheurs et biologistes de l'institut Pasteur

### Vidéo brain-storming

### Prototypage et conception participative

identifier les pratiques réelles des utilisateurs dans les interfaces de l'état de l'art et mettre les utilisateurs en situation d'*inventer les améliorations*.

Image extraite d'une vidéo de brain-storming



# CONCEPTION ET EVALUATION D'INTERFACES

## 4. Visualisation Perspective

**Projet Commun In Situ** - LRI et INRIA Futurs

Michel Beaudouin-Lafon

Olivier Chapuis

Yangzhou Du

Nicolas Roussel

- Conception et développement de prototypes d'interface
- Expérimentations humaines
- Modélisation mathématique de la navigation dans les mondes d'information

**LMP Marseille**

Yves Guiard,

# Visualisation multi-échelle des documents

## Etat de l'art

cross hair (i.e. the view) was actually moving across a stationary world. Once the cross hair was judged to be on the target, validation had to be performed by pressing the left button of the mouse. A hit caused the current array of concentric circles to be replaced at once by the alternate array centered on the other target (located a long way away, out of the view, for difficult trials) and shown in the same color as the new target (see Figure 1). A miss was ineffective, and so an error always had to be corrected before the next movement could start.

Participants were assigned to one of two conditions: zooming with the preferred hand (see of the present experiment), using a wheel mouse; however, we revealed that zooming with the preferred hand and the pointing with the non-preferred hand proved more successful than vice versa, in a kinematic chain interaction scale immediately subsequent component seems to be significant for participants' right-hand mouse.

**Utilization of the Zoom**  
For the first two levels of difficulty (3.2 and 5.1 bits), the zoom facility was used by all participants, who were content with the movements of all the participants. Using as our metric the zoom command (Z, which was...

...the first two levels of difficulty (3.2 and 5.1 bits), the zoom facility was systematically ignored by the participants, who were content to carry out the task with just the mouse.<sup>6</sup> For higher levels of the ID, all the movements of all the participants involved the zoom.

Using as our metric the zoom command (Z, which was...), the zoom facility was systematically ignored by the participants, who were content to carry out the task with just the mouse.<sup>6</sup> For higher levels of the ID, all the movements of all the participants involved the zoom.

Beside practice, the experiment involved a single independent variable, manipulated in a within-participant design: task difficulty, quantified by the ID (3.2, 5.1, 7.1, 9.1, 12.1, 15.1, 23.1, and 30 bits) (for a W of 1 point, these IDs corresponded to distances of 8.3, 32.5, 257.4 (807.3), 1073.9 (888.608), and 1 073 740 825 pixels, respectively).<sup>7</sup> It should be realized that pointing with an ID of 30 bits is equivalent to reaching and selecting a 3-inch target at a distance of over 12,500 miles—half the circumference of our planet. At the first two levels of ID (3.2 and 5.1 bits), zooming was not necessary because at the outset of a trial the zoom could be present or so to show both targets with a size compatible with acquisition. For ID = 8 bits, the zoom began to be very useful, and beyond it became indispensable.

**Procedure Design and Task Instructions**  
Seven healthy right-handed adults, five male and two female, with a mean age of 28.0 years (SD = 1.23 years), volunteered for the experiment. Each participant received seven trials for each level of the ID, yielding a total of 49 trials per participant in a single session. Practice was...

<sup>6</sup> Note that no absolute measurement of variables D and W can be made in a multi-scale interface, these quantities being mouse dependent. The variable that can be quantified is the critical, zoom-independent ratio (ZWR), the distance of the ID.

<sup>7</sup> The only exception was one participant occasionally trying to zoom for a few movements at ID = 5.1 bits, during his second acquisition trial.

Figure 2. Mean zooming amplitude as a function of task difficulty.

cross hair (i.e. the view) was actually moving across a stationary world. Once the cross hair was judged to be on the target, validation had to be performed by pressing the left button of the mouse. A hit caused the current array of concentric circles to be replaced at once by the alternate array centered on the other target (located a long way away, out of the view, for difficult trials) and shown in the same color as the new target (see Figure 1). A miss was ineffective, and so an error always had to be corrected before the next movement could start.

Participants were assigned to one of two conditions: zooming with the preferred hand (see Figure 2). Three-DOF tasks like that of the present experiment can be carried out with a single hand, using a wheel mouse. For the present experiment, however, we resorted to two-handed input because we had found in pilot testing that pointing and zooming could proceed more smoothly, in a partly parallel fashion. We assigned the zooming component of the task to the left hand and the pointing component to the right hand, only than vice versa, in keeping with the principles of Gale's kinematic chain model [12,15]. Since setting interaction scale determines the context of immediately subsequent pointing act, the latter component seems logically dependent on the former requirement for assigning the pointing component to participants' right, preferred hand.

**Independent Variables**  
Beside practice, the experiment involved a single independent variable, manipulated in a within-participant design: task difficulty, quantified by the ID (3.2, 5.1, 7.1, 9.1, 12.1, 15.1, 23.1, and 30 bits) (for a W of 1 point, these IDs corresponded to distances of 8.3, 32.5, 257.4 (807.3), 1073.9 (888.608), and 1 073 740 825 pixels, respectively).<sup>7</sup> It should be realized that pointing with an ID of 30 bits is equivalent to reaching and selecting a 3-inch target at a distance of over 12,500 miles—half the circumference of our planet. At the first two levels of ID (3.2 and 5.1 bits), zooming was not necessary because at the outset of a trial the zoom could be present or so to show both targets with a size compatible with acquisition. For ID = 8 bits, the zoom began to be very useful, and beyond it became indispensable.

**Procedure Design and Task Instructions**  
Seven healthy right-handed adults, five male and two female, with a mean age of 28.0 years (SD = 1.23 years), volunteered for the experiment. Each participant received seven trials for each level of the ID, yielding a total of 49 trials per participant in a single session. Practice was...

<sup>6</sup> Note that no absolute measurement of variables D and W can be made in a multi-scale interface, these quantities being mouse dependent. The variable that can be quantified is the critical, zoom-independent ratio (ZWR), the distance of the ID.

<sup>7</sup> The only exception was one participant occasionally trying to zoom for a few movements at ID = 5.1 bits, during his second acquisition trial.

Figure 3. Mean zooming amplitude as a function of task difficulty.

cross hair (i.e. the view) was actually moving across a stationary world. Once the cross hair was judged to be on the target, validation had to be performed by pressing the left button of the mouse. A hit caused the current array of concentric circles to be replaced at once by the alternate array centered on the other target (located a long way away, out of the view, for difficult trials) and shown in the same color as the new target (see Figure 1). A miss was ineffective, and so an error always had to be corrected before the next movement could start.

Participants were assigned to one of two conditions: zooming with the preferred hand (see Figure 2). Three-DOF tasks like that of the present experiment can be carried out with a single hand, using a wheel mouse. For the present experiment, however, we resorted to two-handed input because we had found in pilot testing that pointing and zooming could proceed more smoothly, in a partly parallel fashion. We assigned the zooming component of the task to the left hand and the pointing component to the right hand, only than vice versa, in keeping with the principles of Gale's kinematic chain model [12,15]. Since setting interaction scale determines the context of immediately subsequent pointing act, the latter component seems logically dependent on the former requirement for assigning the pointing component to participants' right, preferred hand.

**Independent Variables**  
Beside practice, the experiment involved a single independent variable, manipulated in a within-participant design: task difficulty, quantified by the ID (3.2, 5.1, 7.1, 9.1, 12.1, 15.1, 23.1, and 30 bits) (for a W of 1 point, these IDs corresponded to distances of 8.3, 32.5, 257.4 (807.3), 1073.9 (888.608), and 1 073 740 825 pixels, respectively).<sup>7</sup> It should be realized that pointing with an ID of 30 bits is equivalent to reaching and selecting a 3-inch target at a distance of over 12,500 miles—half the circumference of our planet. At the first two levels of ID (3.2 and 5.1 bits), zooming was not necessary because at the outset of a trial the zoom could be present or so to show both targets with a size compatible with acquisition. For ID = 8 bits, the zoom began to be very useful, and beyond it became indispensable.

**Procedure Design and Task Instructions**  
Seven healthy right-handed adults, five male and two female, with a mean age of 28.0 years (SD = 1.23 years), volunteered for the experiment. Each participant received seven trials for each level of the ID, yielding a total of 49 trials per participant in a single session. Practice was...

<sup>6</sup> Note that no absolute measurement of variables D and W can be made in a multi-scale interface, these quantities being mouse dependent. The variable that can be quantified is the critical, zoom-independent ratio (ZWR), the distance of the ID.

<sup>7</sup> The only exception was one participant occasionally trying to zoom for a few movements at ID = 5.1 bits, during his second acquisition trial.

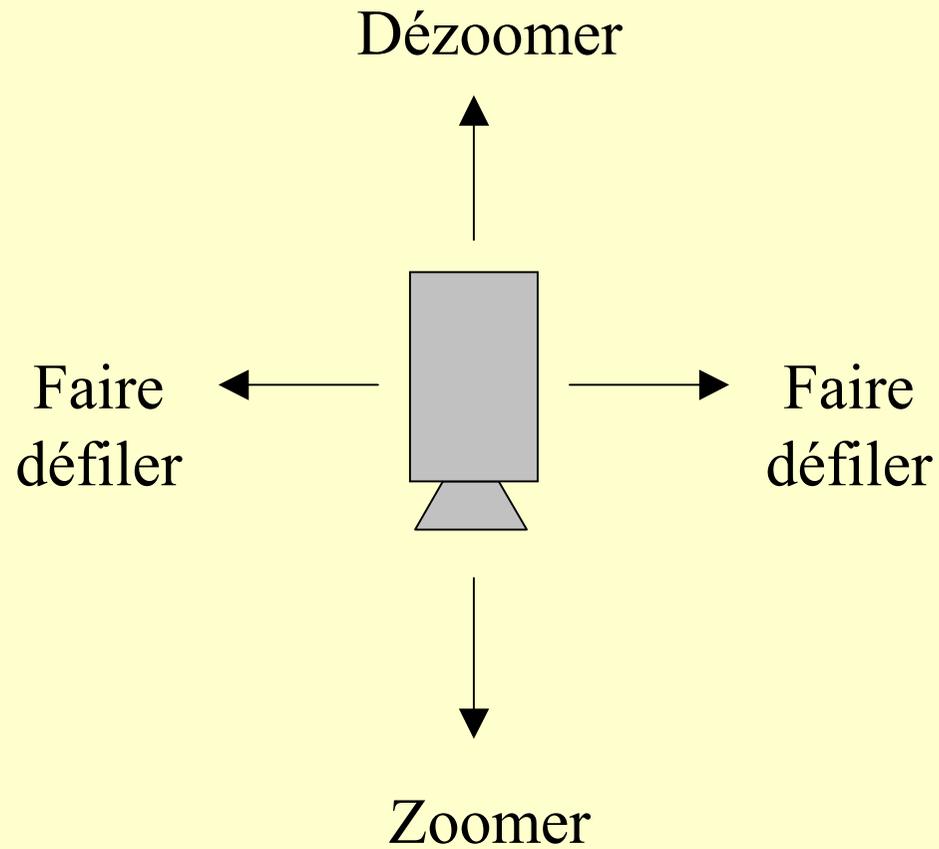
Figure 4. Multi-scale pointing towards a target.

Using the scaling invariant (equation 1.1), we first compute  $s_{0.1}$  and  $s_{0.2}$ . At scale  $s_{0.1}$ , the view (size 1) covers the distance to target,  $L$ , and the target itself (size  $W$ ), so we have:  
 $(L - W) \cdot 1 = L / s_{0.1}$  or  $s_{0.1} = L / (L - W)$   
 At scale  $s_{0.2}$ , the view (size 2) covers the target (size  $W$ ) so we have:  
 $W \cdot 2 = W / s_{0.2}$   
 or  $s_{0.2} = 2 / W$   
 We now compute  $2D$ :  
 $2D = \log_{s_{0.2}} L_{0.1} - \log_{s_{0.1}} W - \log_{s_{0.2}} W - \log_{s_{0.1}} W - \log_{s_{0.2}} W - \log_{s_{0.1}} W - 2L$   
 therefore the distance to navigate in zoom-in-out space is exactly the index of difficulty of the

**Bifocale**  
faible contraste micro-macro  
simultanément

**Fisheye**  
~ idem  
simultanément

**Pan-plus-zoom**  
large gamme d'échelles  
séquentiellement



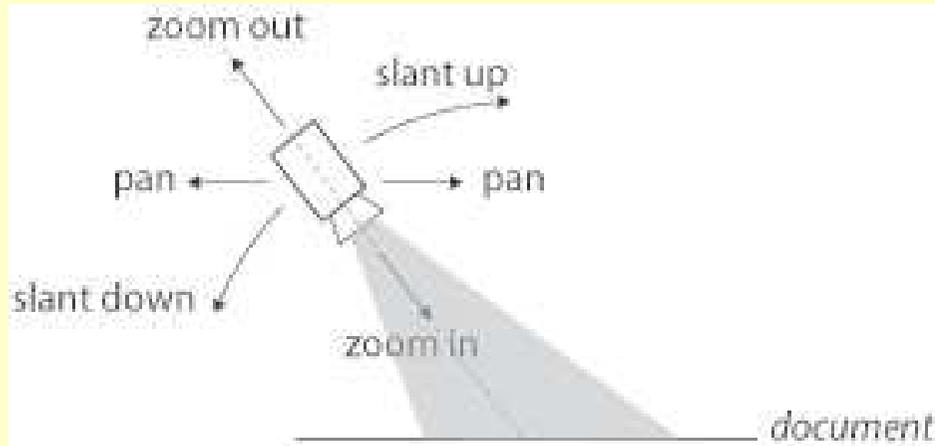
### **Caméra virtuelle**

Trois degrés de liberté de translation

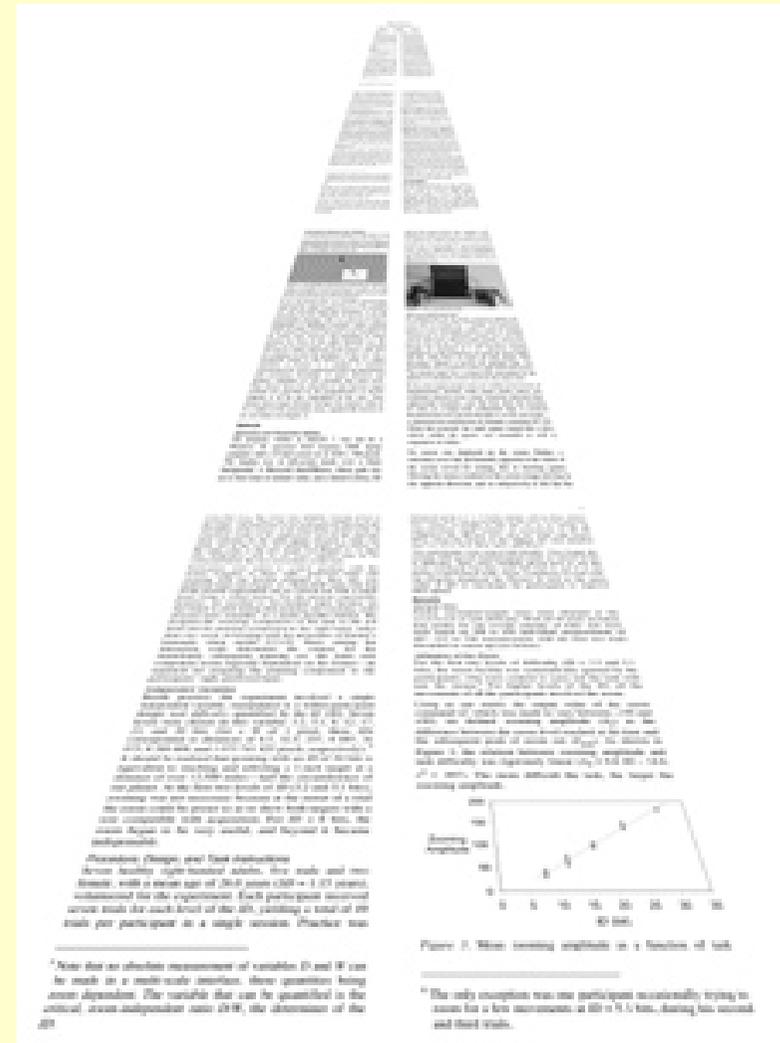
pas de *rotations* de la caméra

---

Surface du document



## Inclinaison de la caméra virtuelle



## Vue en perspective

Intrinsèquement et naturellement multi-échelle

Vidéo

# Micromégas

Approches multi-échelles pour la navigation  
dans les masses de données familières



Site web

<http://insitu.lri.fr/micromegas/>

Site wiki

<http://wiki.lri.fr/micromegas/>

Alias email

[micromegas@lri.fr](mailto:micromegas@lri.fr)

# Navigation multi-échelle

