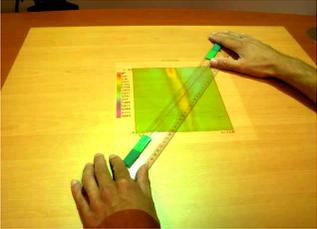


GeoTUI



www.estia.fr/~geotui

GeoTUI : Une Interface Tangible pour les Géosciences

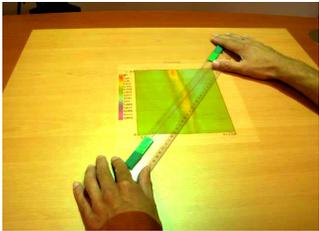
Guillaume Rivière

ESTIA, LaBRI

Présentation au LUCID Group

Université de Liège

14 Février 2008

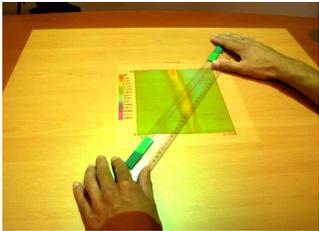


Plan

Besoin de nouvelles formes d'interaction

GeoTUI

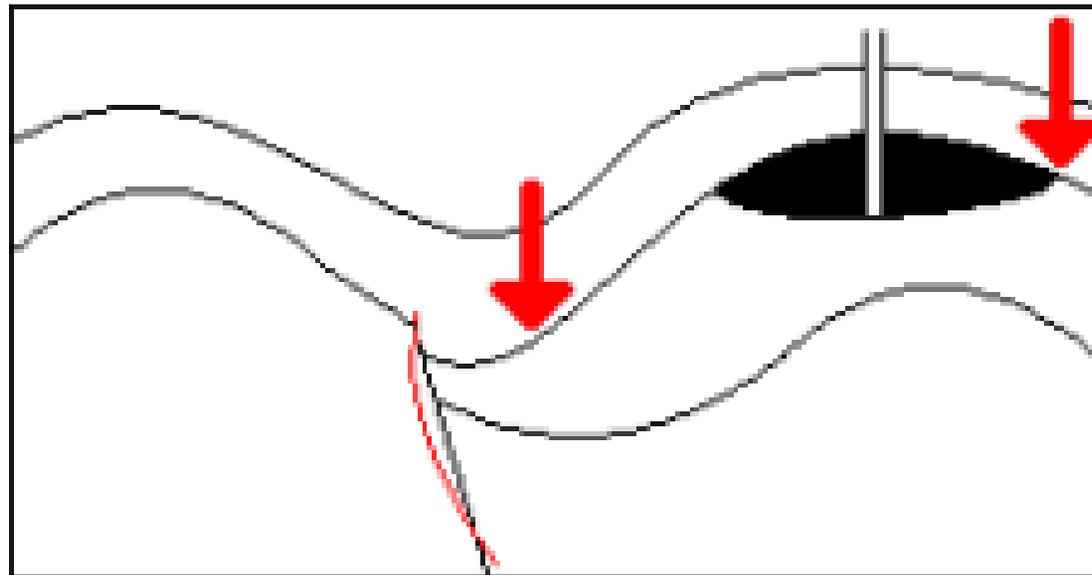
Etude utilisateur de 4 interactions

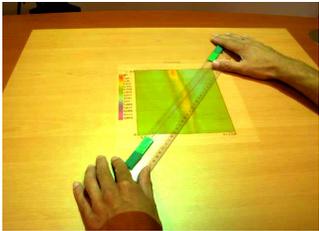


www.estia.fr/~geotui

Prospection

- Décider la construction d'un puits

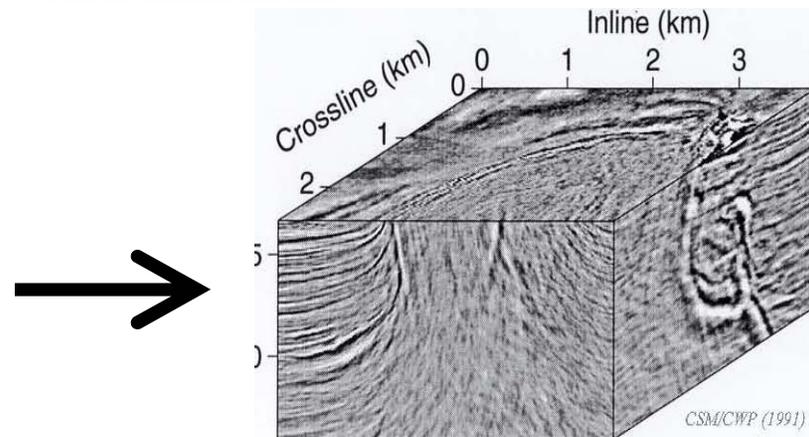
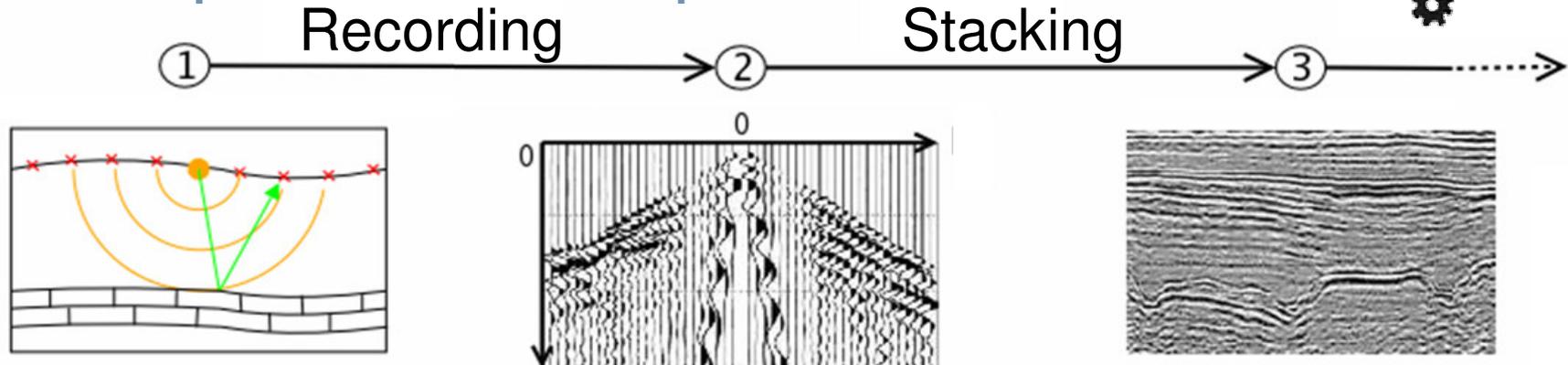


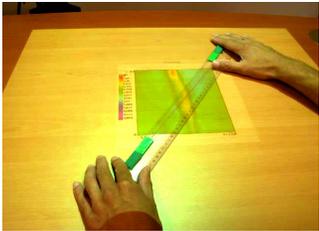


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Calculer un modèle

- Acquisition sismique

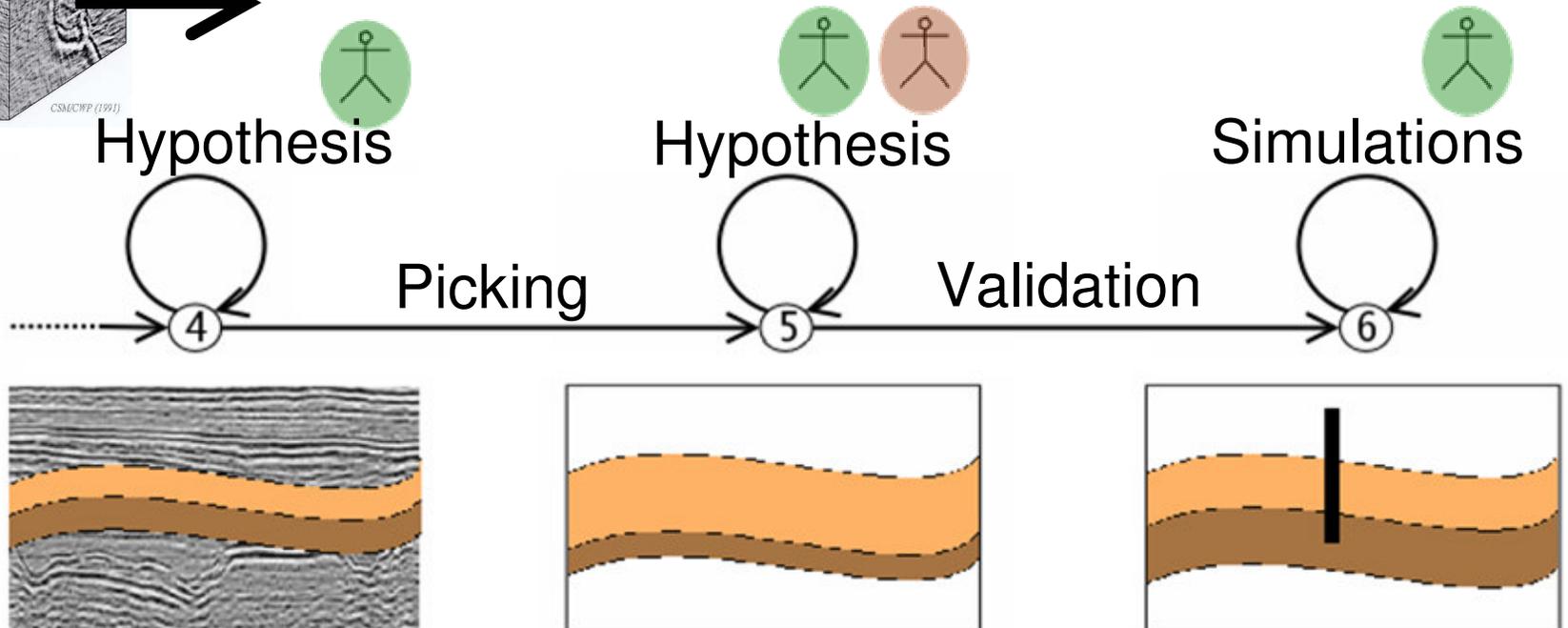
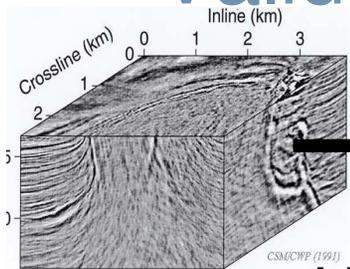




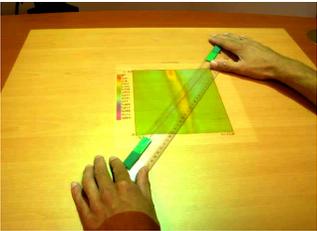
www.estia.fr/~geotui

Calculer un modèle

- Validation d'hypothèses



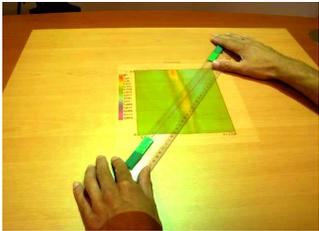
Besoin de changer l'interaction



www.estia.fr/~geotui

- GUI des logiciels de simulation géologique
 - Difficultés pour interagir avec les données
 - Difficultés pour collaborer en co-présence





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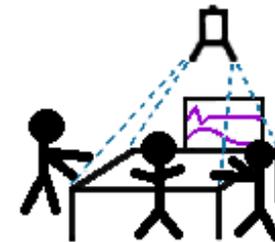
Un nouveau système

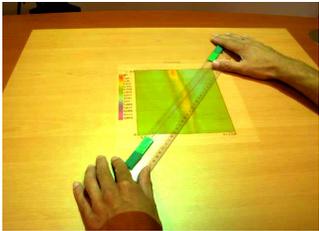
- Interface Tangible



- sur un TableTop avec vision-projection

dédié aux géosciences





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Travaux préliminaires

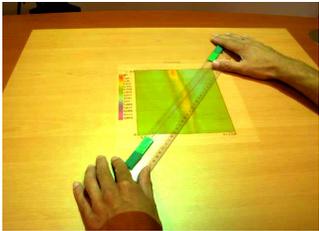
- Les origines



Wellner, 1993



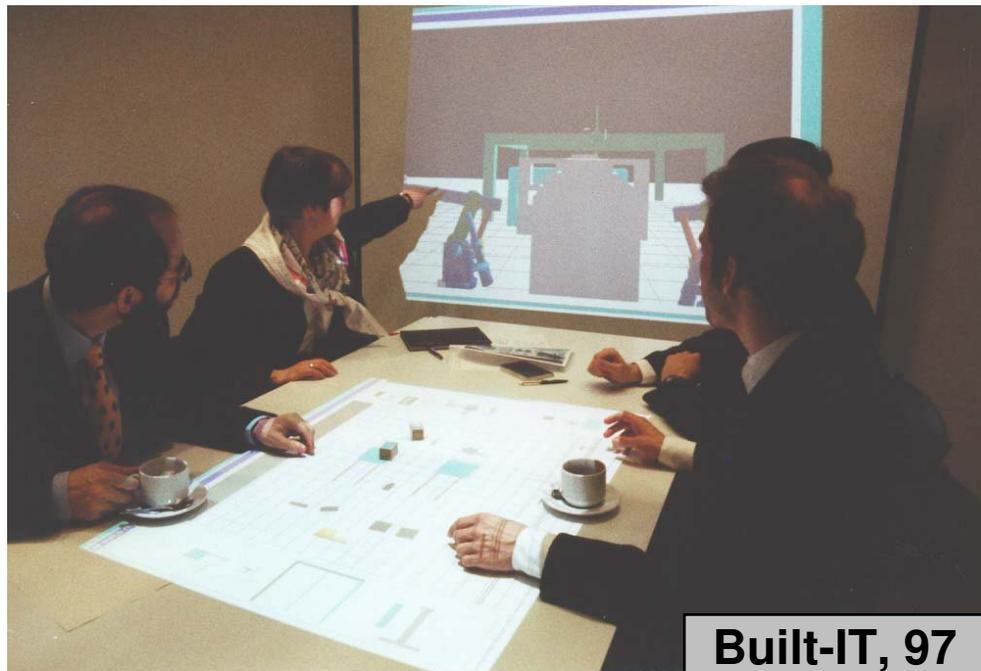
Fitzmaurice, Ishii, Buxton, 1995



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Travaux préliminaires

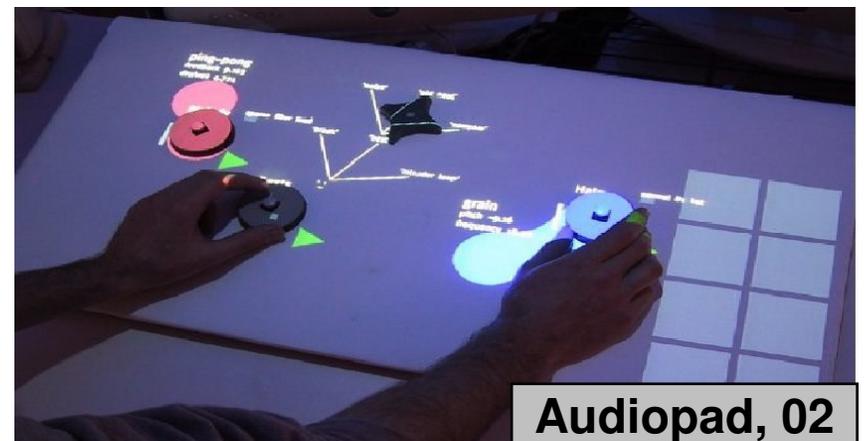
- Tabletop + TUI



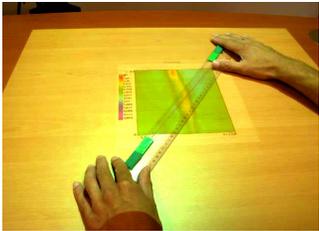
Built-IT, 97



IP Design Workbench, 03



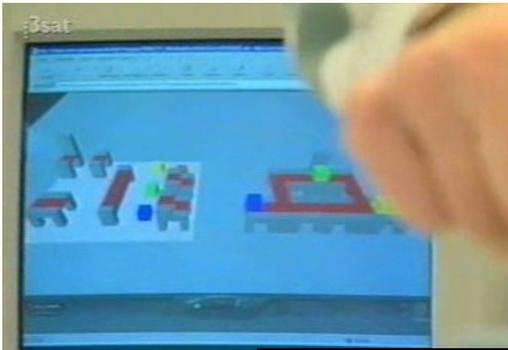
Audiopad, 02



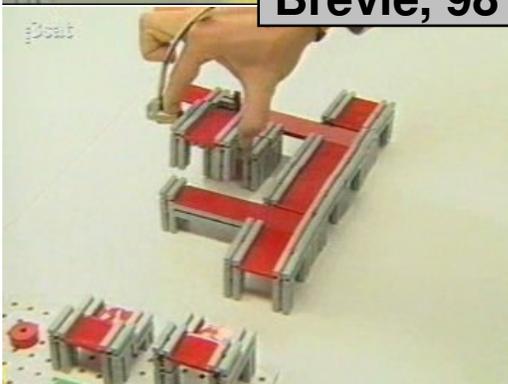
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Travaux préliminaires

- Champs d'application



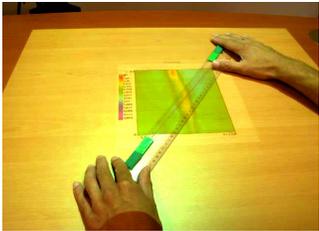
Brevie, 98



Virtual Design Workbench, 03



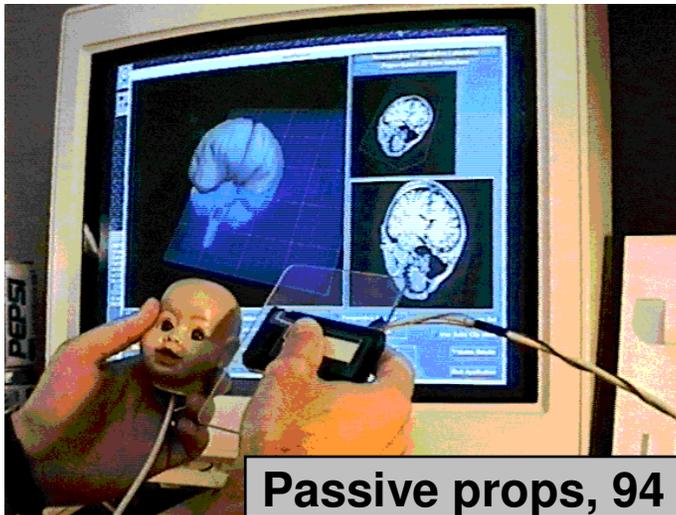
Illuminating Clay, 02



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Travaux préliminaires

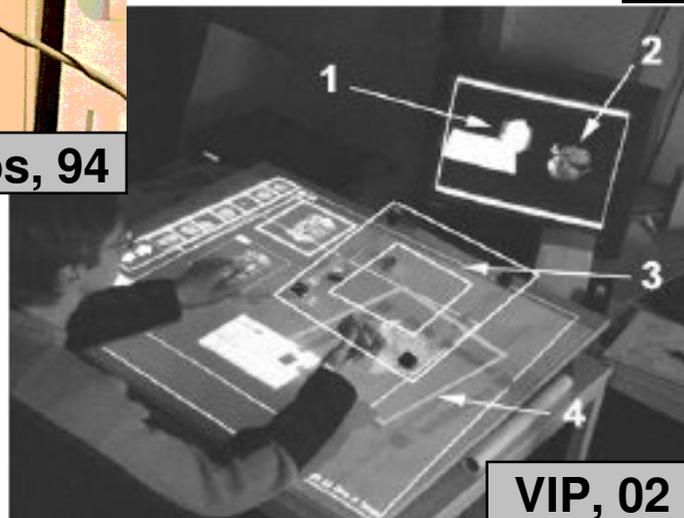
- Coupes dans données 3D



Passive props, 94

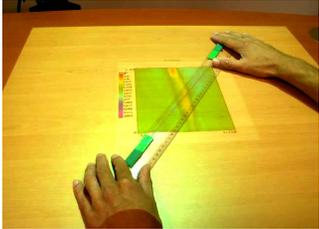


Phoxel-Space, 04



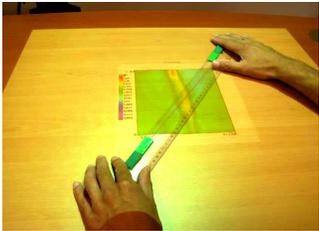
VIP, 02





Nos contraintes spécifiques

- Les besoins pour les géosciences
 - Interagir autour d'un tabletop
 - Faire coïncider espaces d'action et de perception **Norman 1988**
 - Sélection de plan de coupe verticaux

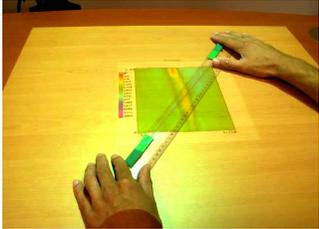


Plan

Besoin de nouvelles formes d'interaction

GeoTUI

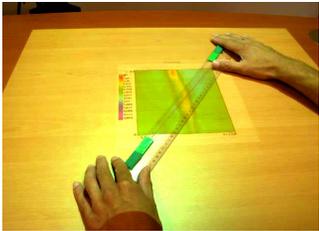
Etude utilisateur de 4 interactions



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Tâches métier

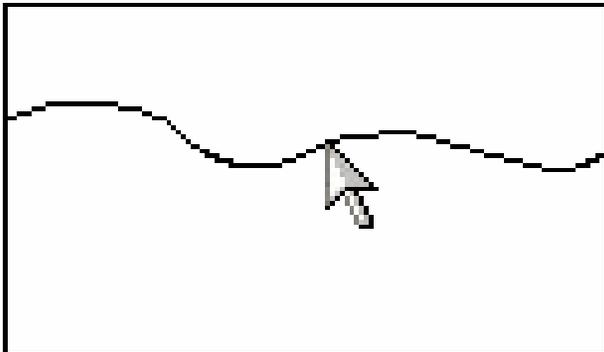
- Identification de 4 scénarios
 - Editer des courbes
 - Attribuer des propriétés
 - Simulation dans les réservoirs
 - Sélectionner des plan de coupe



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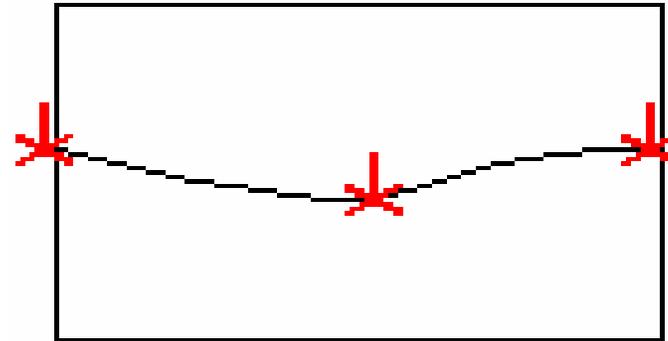
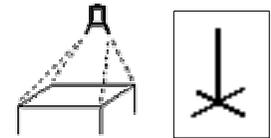
Editer les courbes

Interface Graphique

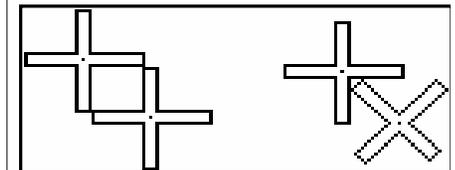


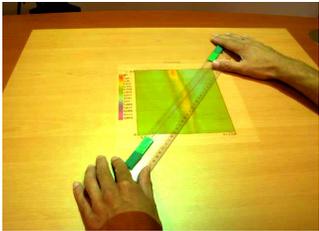
- Travail en solitaire
- Chaque action demande plusieurs interventions :
 - o Dessiner une ligne
 - o Parcours de menus
 - o Chercher la gomme

Interface Tangible



- + Permet travail collaboratif
- + Actions atomiques
- + Un seul type d'interacteur
- Précision du système ?
- Précision des croix ?

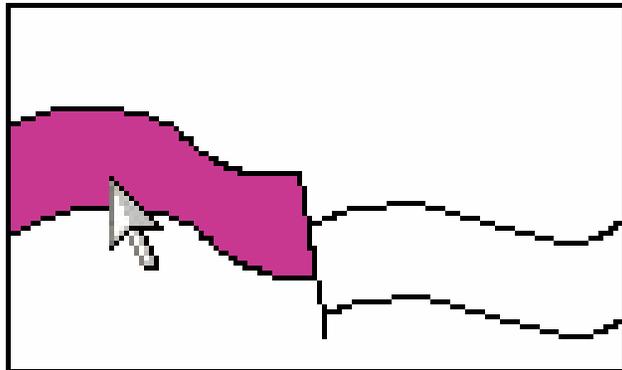




www.estia.fr/~geotui

Attribuer des propriétés

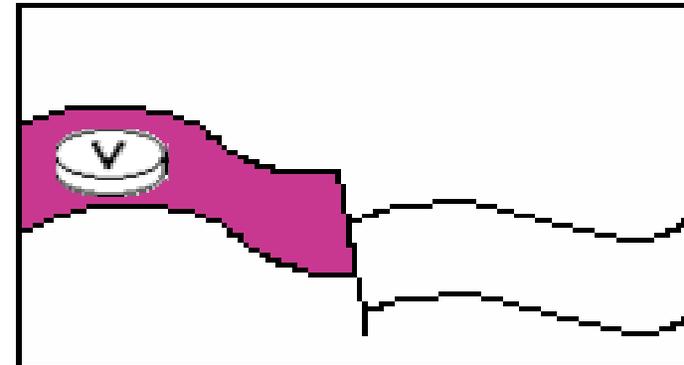
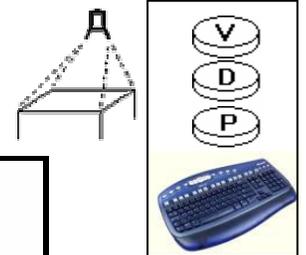
Interface Graphique



1. Sélectionner la zone
2. Sélectionner l'attribut
3. Donner la valeur

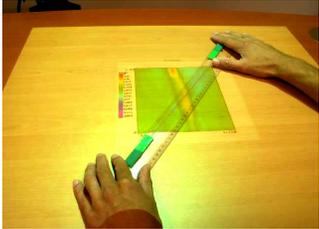
- On doit quitter le modèle pour sélectionner l'attribut, ouvrir une fenêtre, etc..., etc...

Interface Tangible



1. Poser un palet dans la zone
2. Donner la valeur

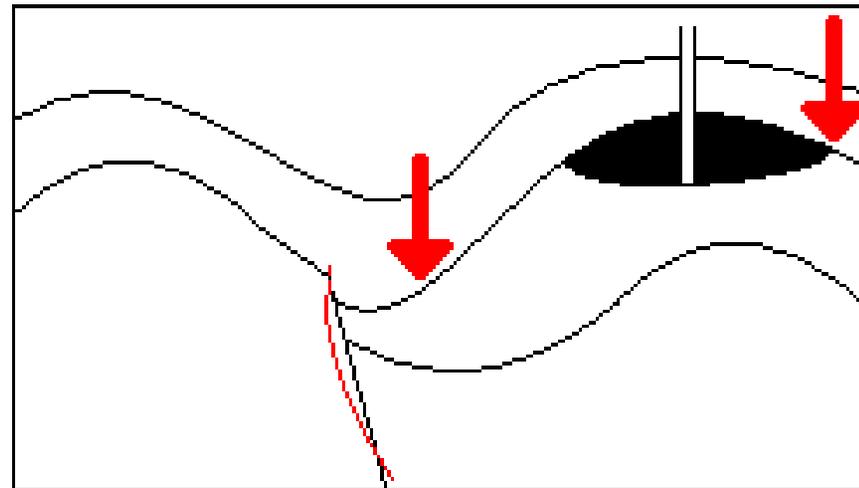
+ Interaction directe avec le modèle
+ Permet travail collaboratif

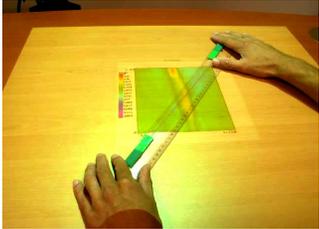


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Exploiter le modèle

- Simulation dans les réservoirs :
 - Forage
 - Pression
 - Production



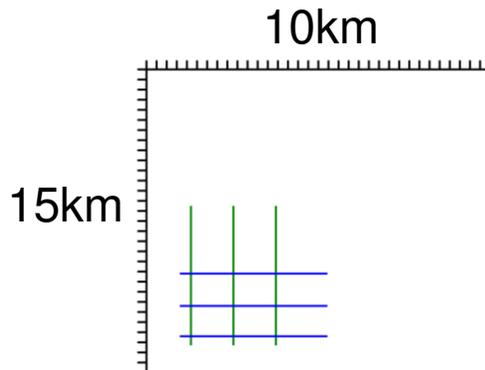


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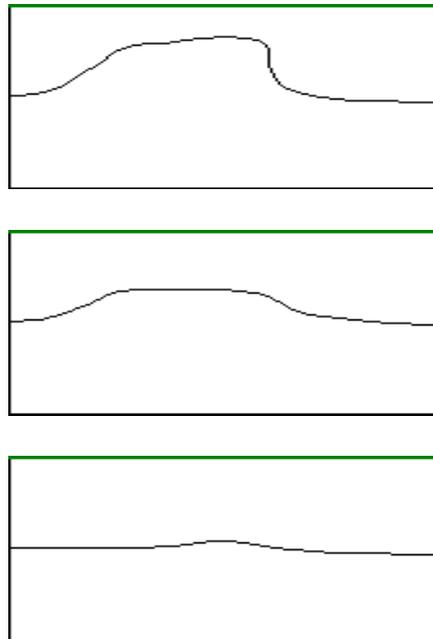
Une tâche centrale

- Obtenir des plans de coupe

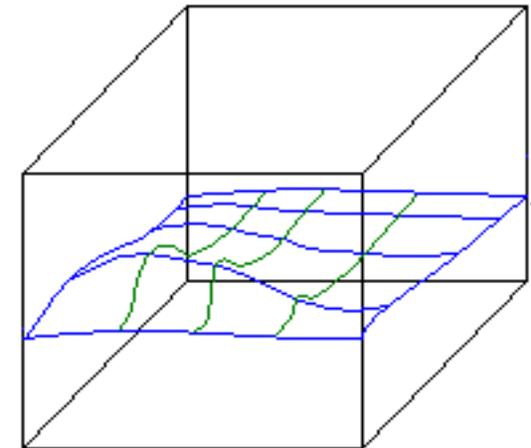
Carte de dessus

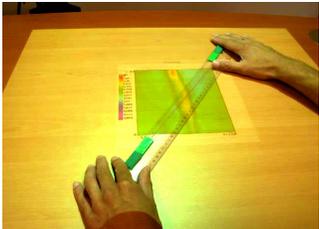


Plans de coupe



Représentation mentale

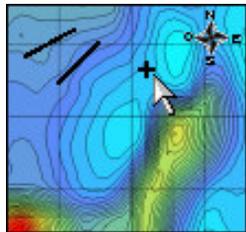




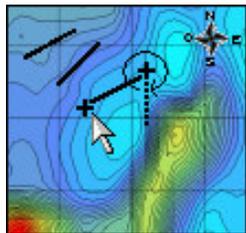
www.estia.fr/~geotui

Une ligne de coupe

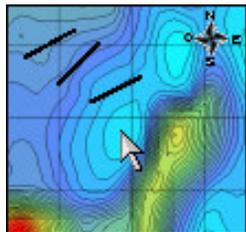
Interface Graphique



1. Poser le premier point



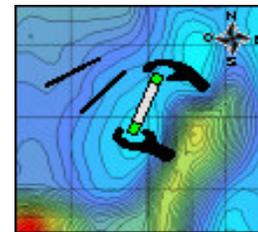
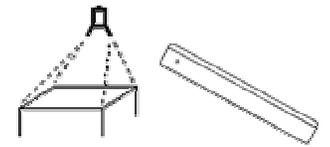
2. Poser le deuxième point
(Perte de liberté)



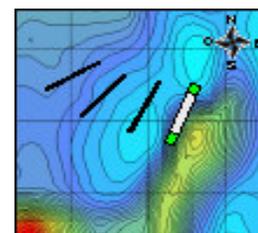
3. Valider

- Action "complexe"
- Perte de liberté

Interface Tangible

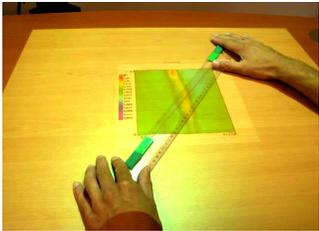


1. Poser la règle



2. Valider

- + Collaboration
- + Action simple naturelle
- + Toutes les libertés



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Quatre interactions

- Sélection d'une ligne de coupe

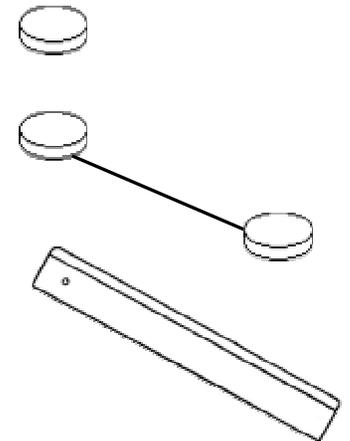
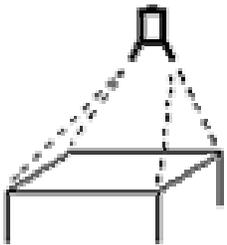


— souris (*M*)

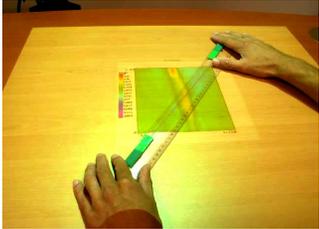
— 1-palet (*1P*)

— 2-palets (*2P*)

— règle (*R*)



- Une interaction est-elle meilleure ?



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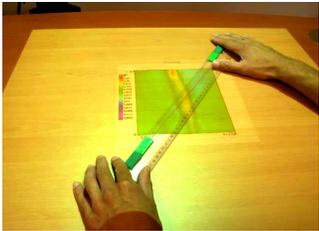
Valider les actions

- Un boîtier

“People would be better served if we would return to control through physical objects, to real knobs, sliders, buttons, to simpler, more concrete objects and actions”

Norman 1999

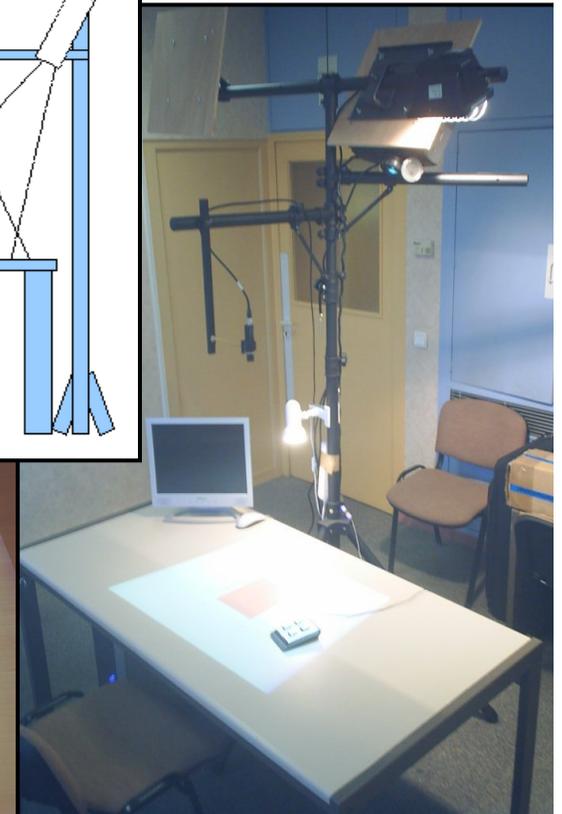
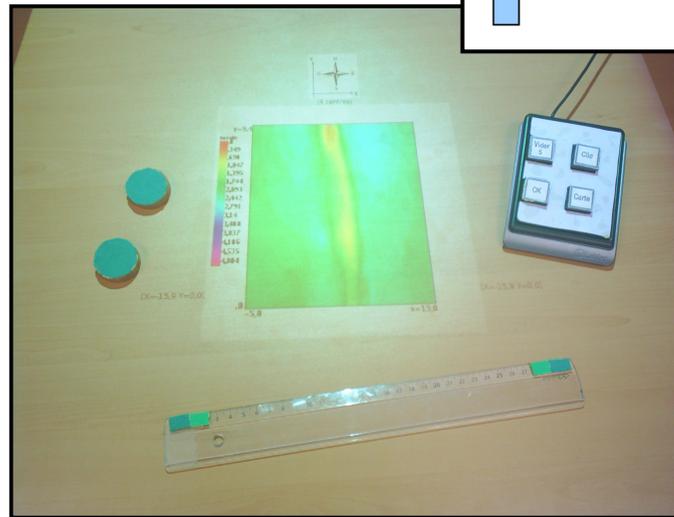
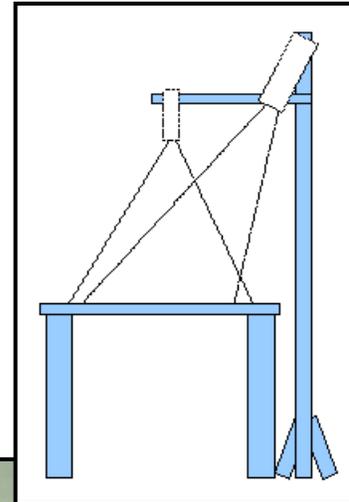


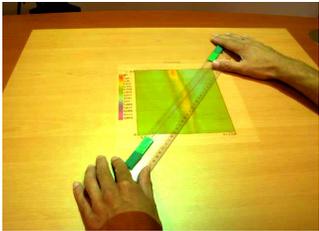


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Dispositif matériel

- Trépied
- Video-projecteur usuel
- Camera RGB
- Pavé USB



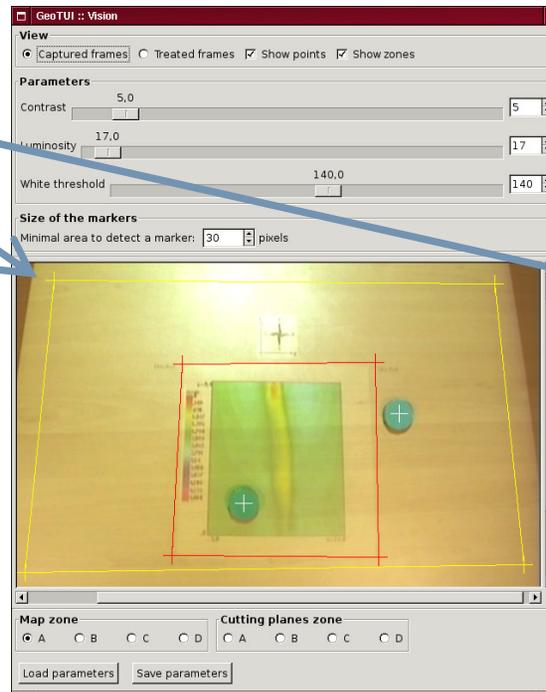
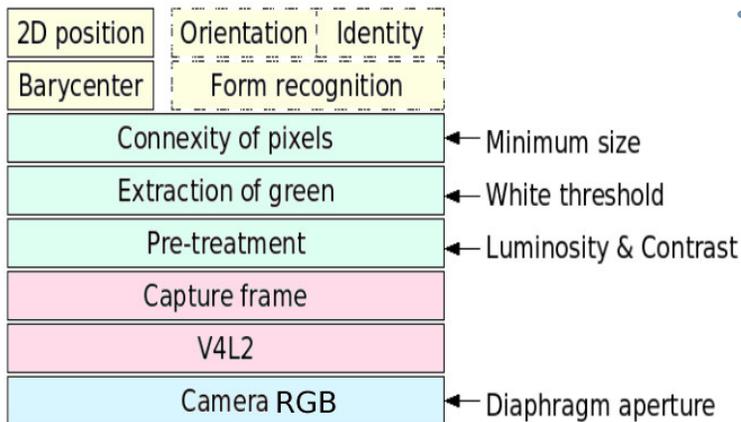


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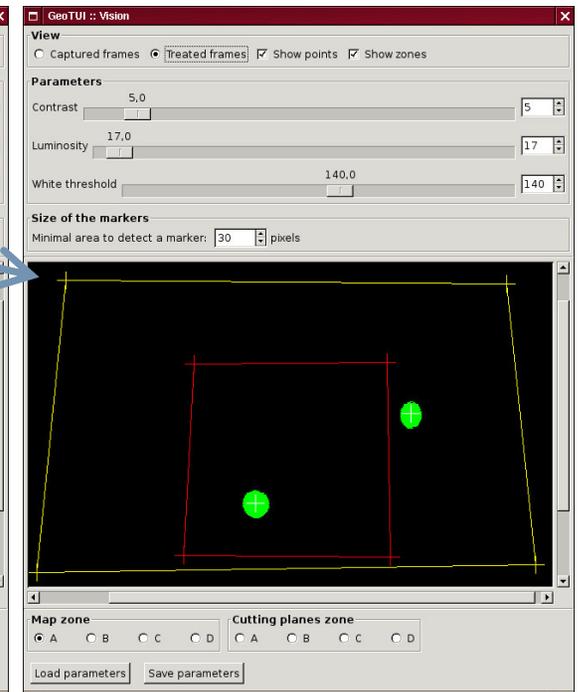
Vision par ordinateur

- Détection des objets physiques et de la carte

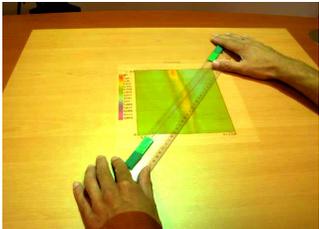
Vue de la caméra



Capture brute



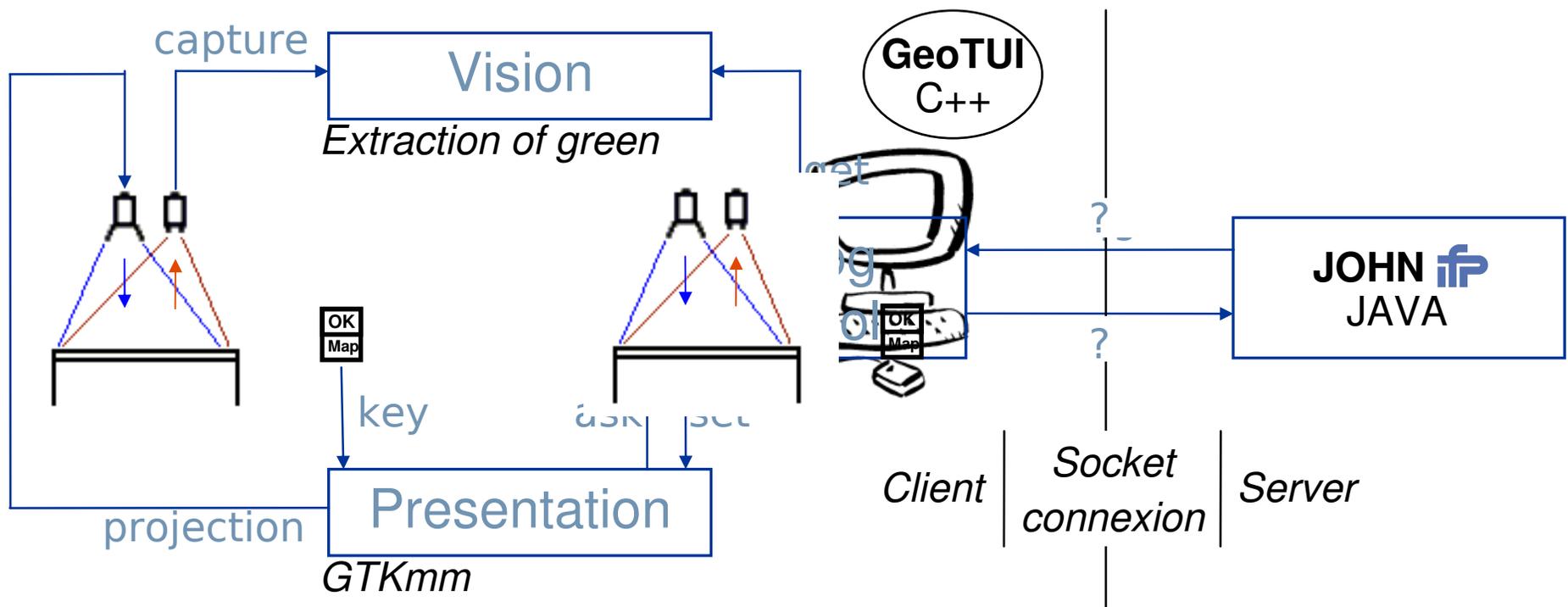
Après traitement

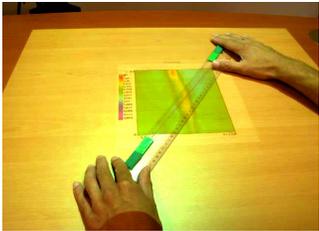


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Architecture logicielle

- Substitution de l'interface graphique





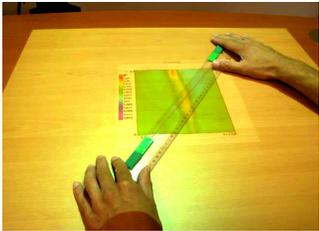
Plan

Besoin de nouvelles formes d'interaction

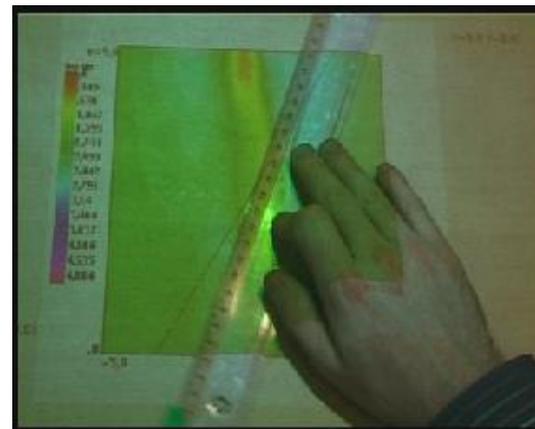
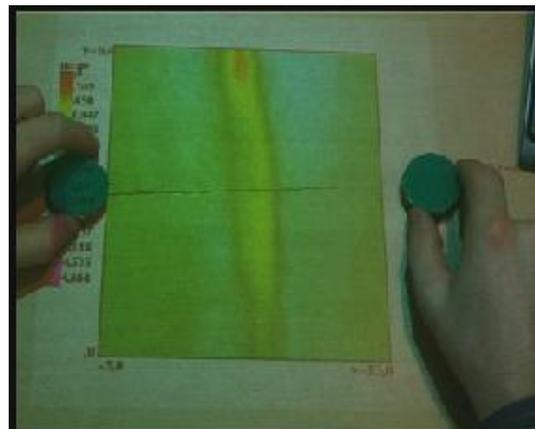
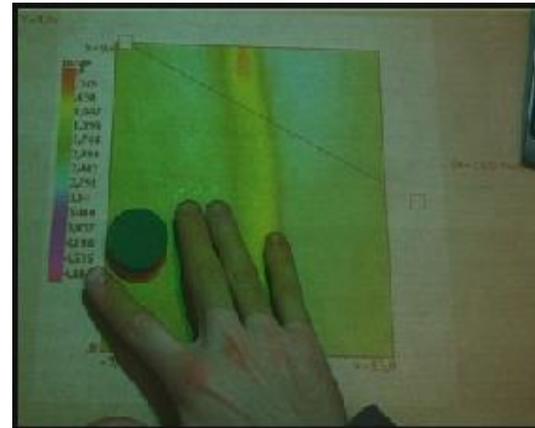
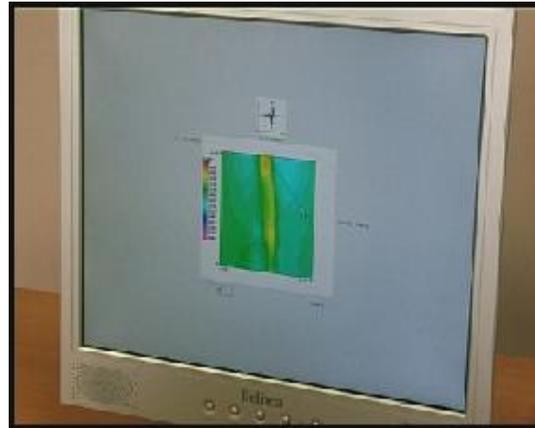
GeoTUI

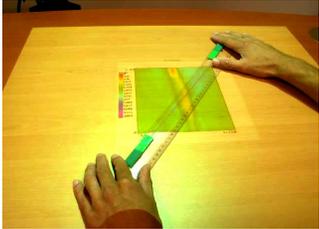
Etude utilisateur de 4 interactions

Expérimentations



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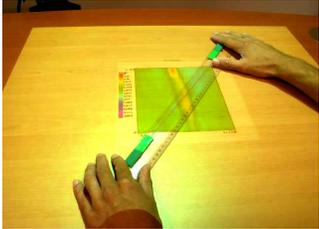




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Expérimentations

- Deux études utilisateur
 - Sur le lieu de travail
 - Avec une douzaines de personnes de l'IFP
 - Questionnaires qualitatifs et subjectifs
 - Fichier de log pour les actions de l'utilisateur
 - Conditions “within-subject”
 - Contrebalancer l'ordre GUI / TUI
 - Contrebalancer l'ordre des interacteurs tangibles

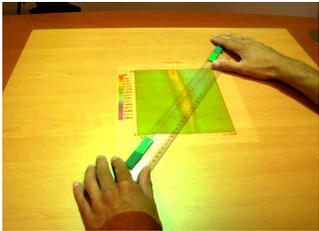


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1ère étude utilisateur

- Acceptation d'une telle interface ?
- Quel interacteur est associé à la tâche ?

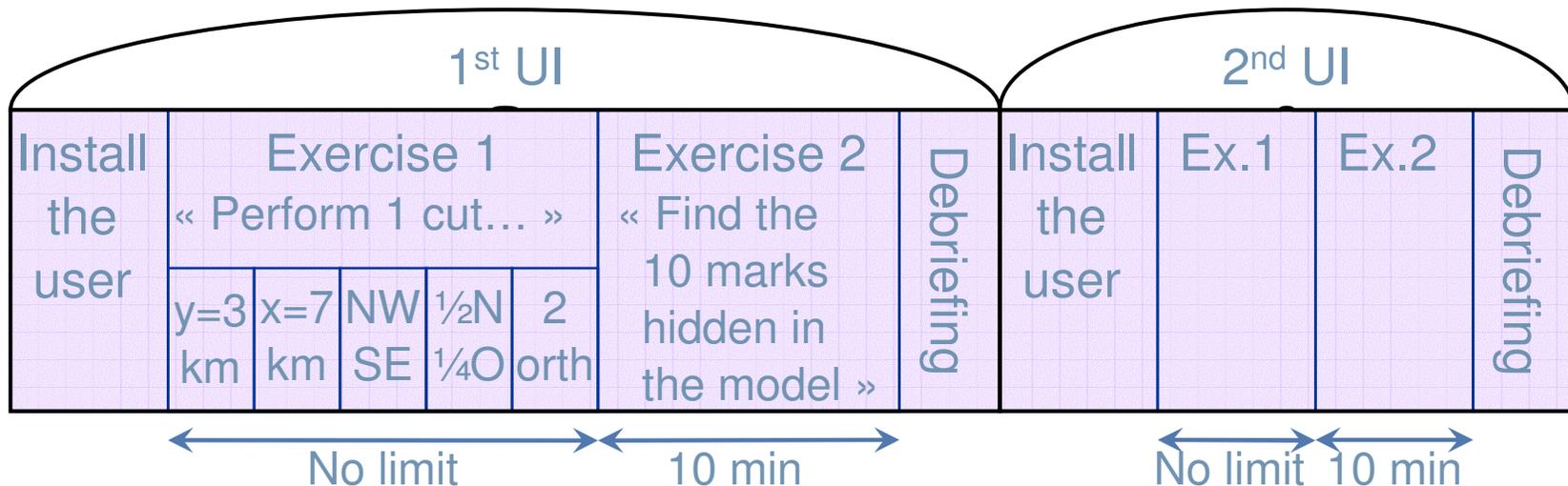




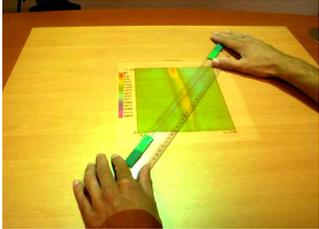
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1ère étude utilisateur

- Conditions de l'étude



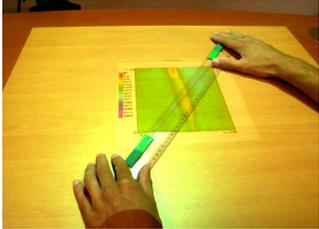
	1 st UI	2 nd UI
$S_1 = \frac{1}{2} \{\text{Subjects}\}$	GUI	TUI
$S_2 = \{\text{Subjects}\} \setminus S_1$	TUI	GUI



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Resultats de la 1ère étude

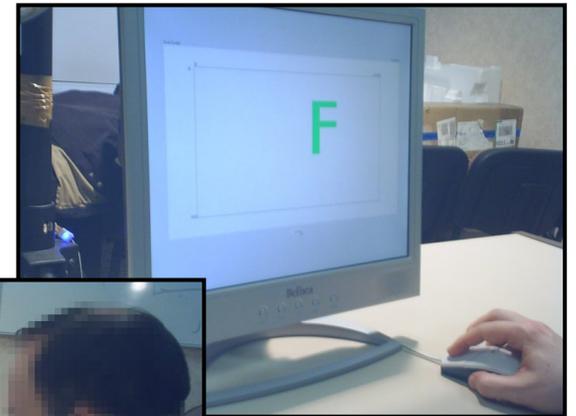
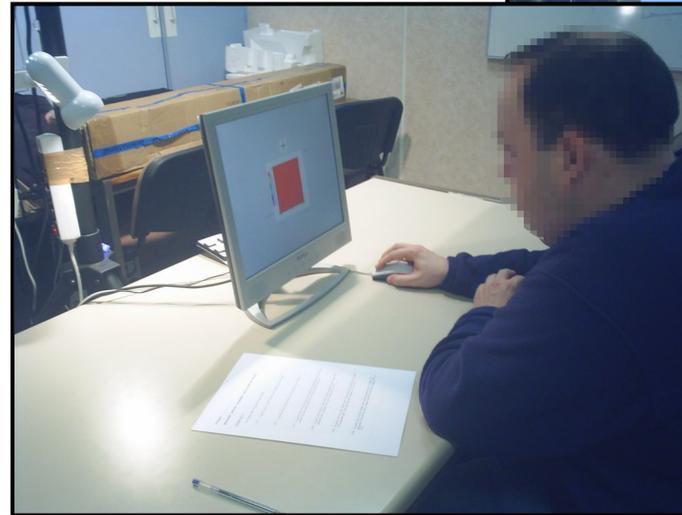
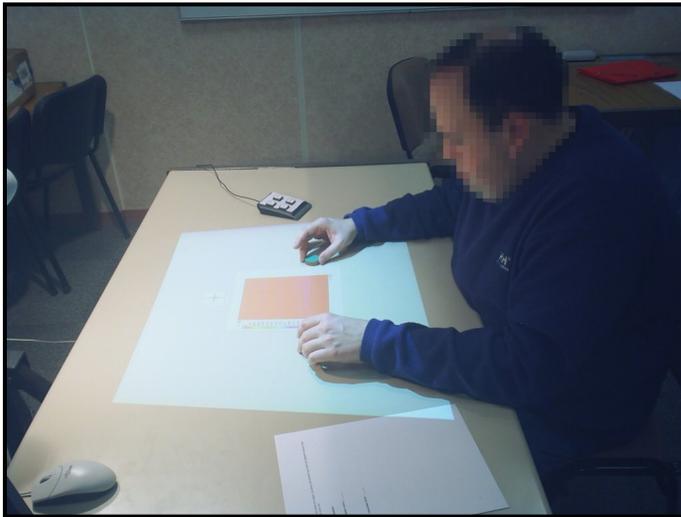
- Acceptation des geophysiciens
 - Personne ne refuse d'utiliser la TUI
 - 2 sujets (20%) refuse d'utiliser la GUI
 - La TUI avait l'avantage d'être innovante
- 100% des sujets ont pris la règle

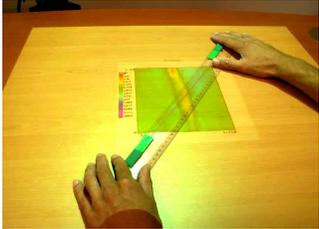


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2nd étude utilisateur

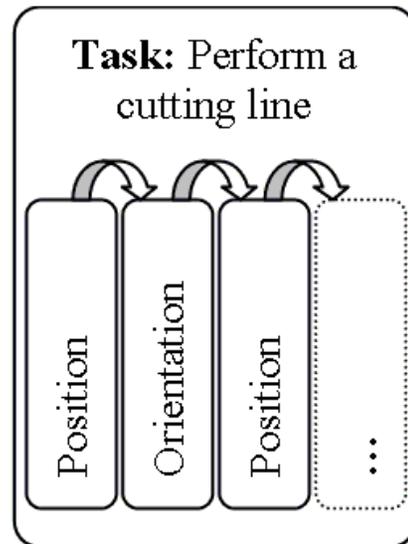
- Evaluer et comparer les quatre interactions
 - Temps de manipulation
 - Qualité des résultats





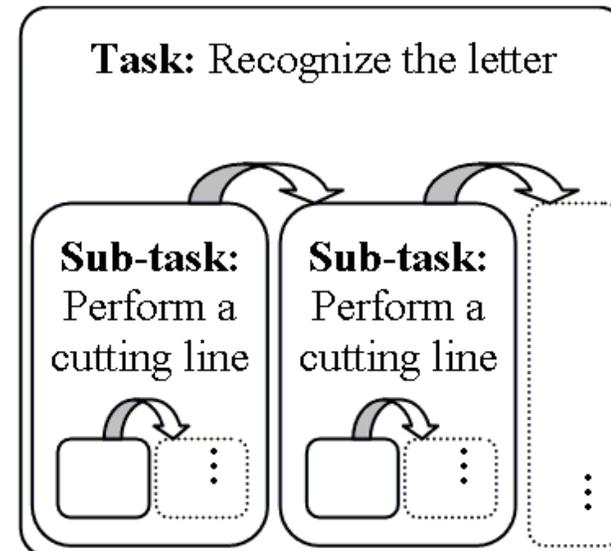
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2nd étude utilisateur



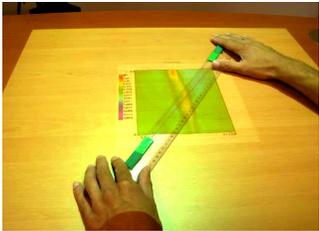
Tâche simple

Payne 1986



Tâche composée

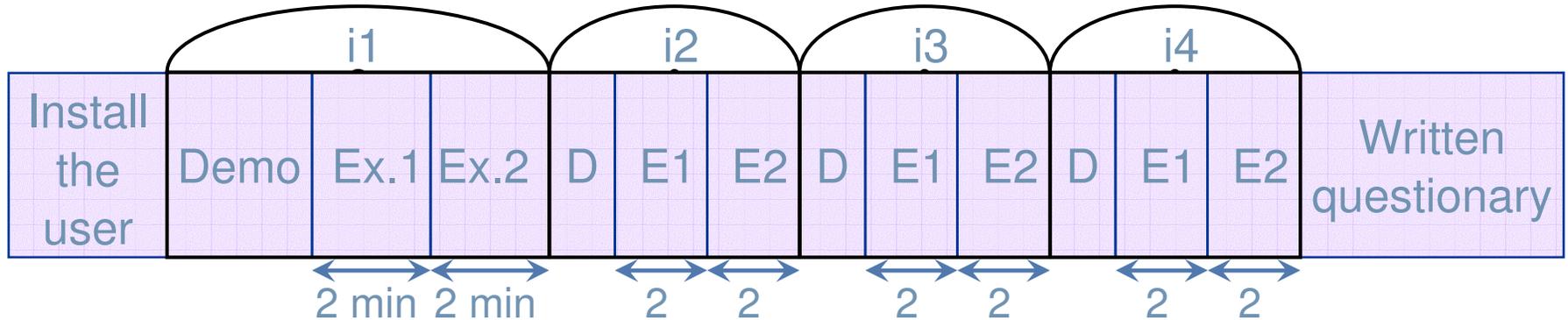
- Exercise1: 6 tâches simples
- Exercise2: 1 tâche composée



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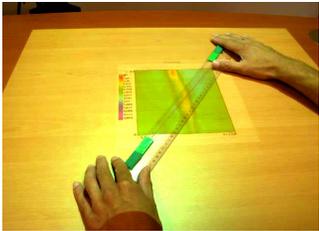
2nd étude utilisateur

- Conditions de l'étude



	i1	i2	i3	i4
Subject 1	<i>M</i>	<i>1P</i>	<i>2P</i>	<i>R</i>
Subject 3	<i>M</i>	<i>1P</i>	<i>R</i>	<i>2P</i>
Subject 5	<i>M</i>	<i>2P</i>	<i>1P</i>	<i>R</i>
Subject 7	<i>M</i>	<i>2P</i>	<i>R</i>	<i>1P</i>
Subject 9	<i>M</i>	<i>R</i>	<i>1P</i>	<i>2P</i>
Subject 11	<i>M</i>	<i>R</i>	<i>2P</i>	<i>1P</i>

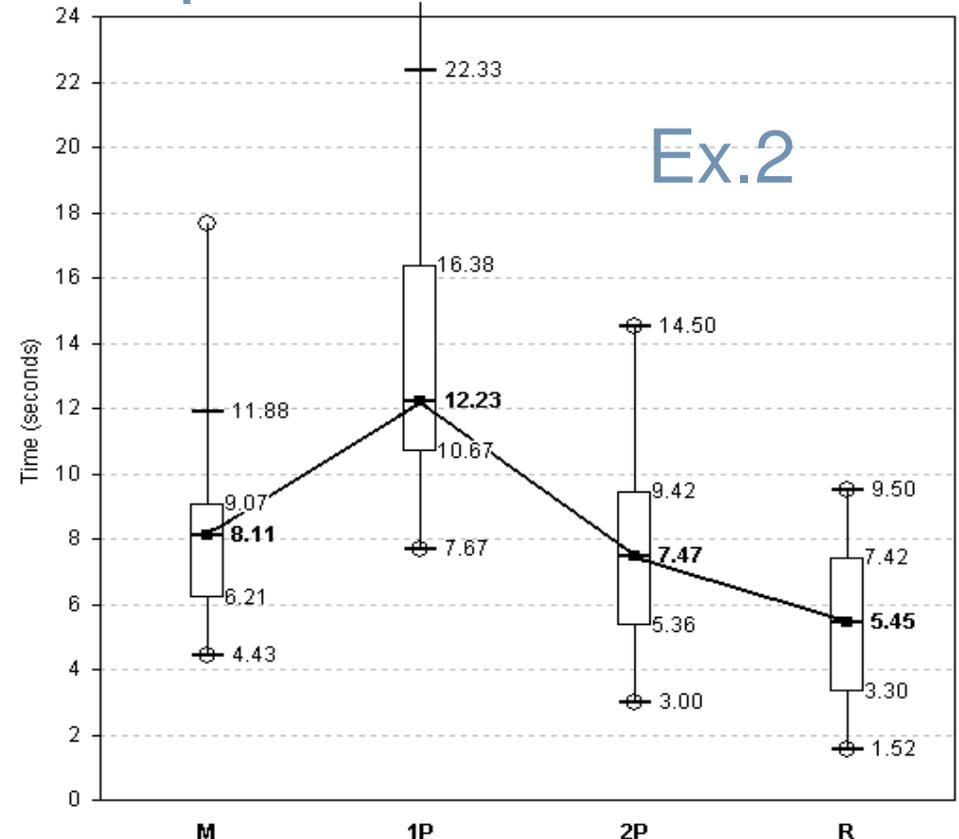
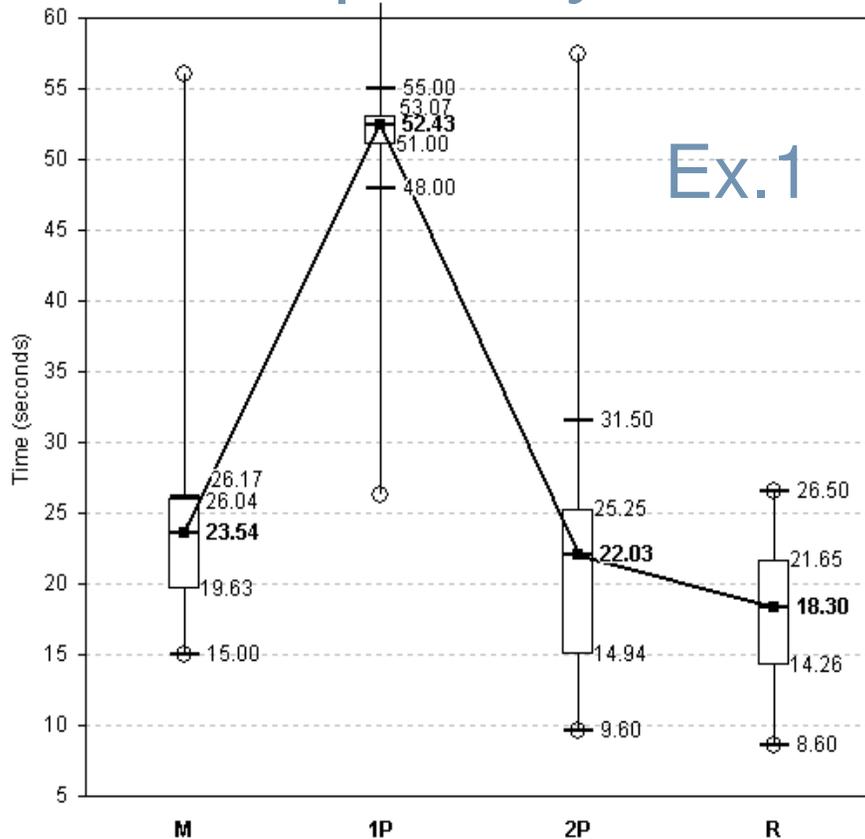
	i1	i2	i3	i4
Subject 2	<i>1P</i>	<i>2P</i>	<i>R</i>	<i>M</i>
Subject 4	<i>1P</i>	<i>R</i>	<i>2P</i>	<i>M</i>
Subject 6	<i>2P</i>	<i>1P</i>	<i>R</i>	<i>M</i>
Subject 8	<i>2P</i>	<i>R</i>	<i>1P</i>	<i>M</i>
Subject 10	<i>R</i>	<i>1P</i>	<i>2P</i>	<i>M</i>
Subject 12	<i>R</i>	<i>2P</i>	<i>1P</i>	<i>M</i>

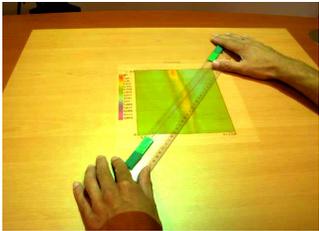


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Resultat de la 2nd étude

- Temps moyens de manipulation

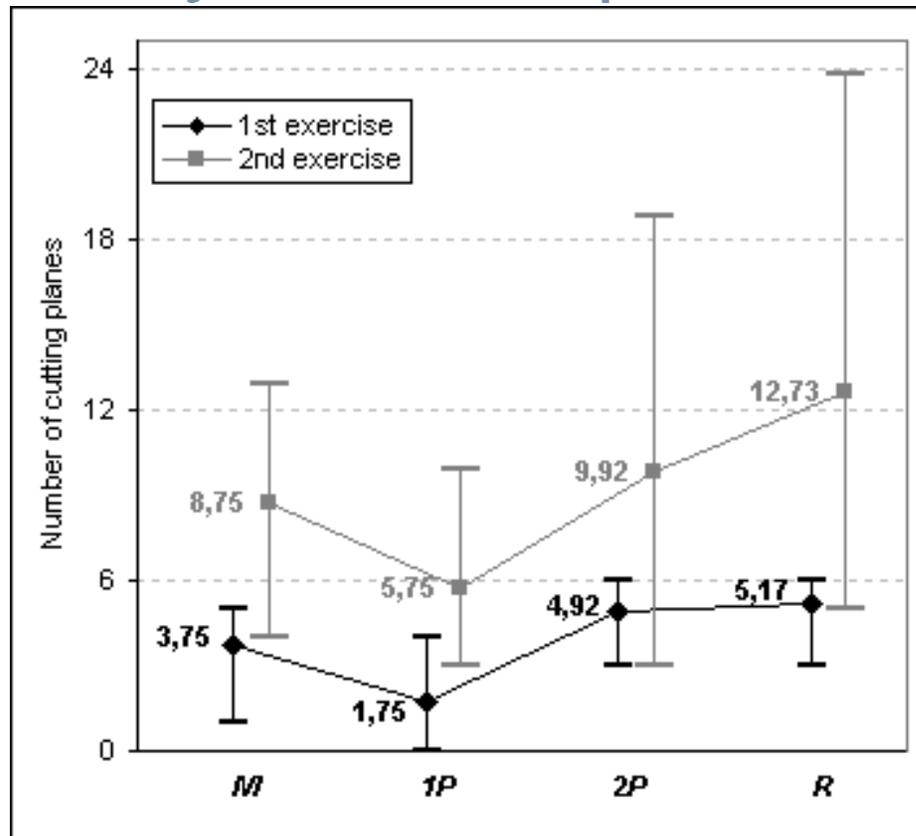


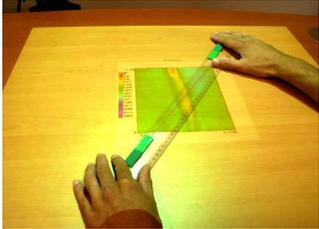


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Resultat de la 2nd étude

- Nombre moyen de coupes effectuées

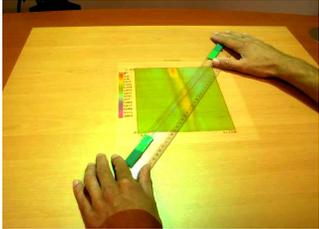




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Questionnaires

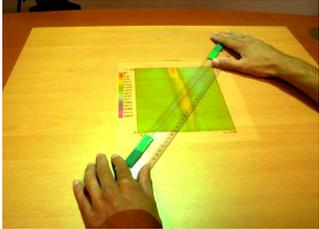
- Remarques des utilisateurs
 - “Avec la souris on est parfois plus concentré sur l’outil que sur la reconnaissance des lettres”
 - “Sur la table, on a les mains sur la carte, c’est concrêt, on a moins de chance de se tromper”



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Conclusion

- Tabletop+TUI pour les géosciences
 - Simplifier l'interaction
 - Faciliter le travail à plusieurs
- Plateforme mobile et à coût modéré
- Deux expériences utilisateur
 - Adhésion des géophysiciens
 - Le choix de la règle est justifié pour la sélection d'une ligne de coupe

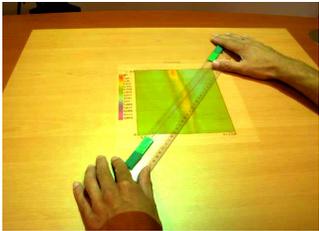


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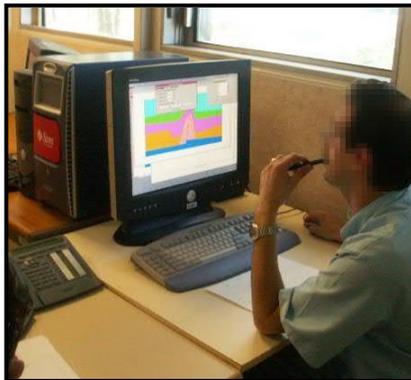
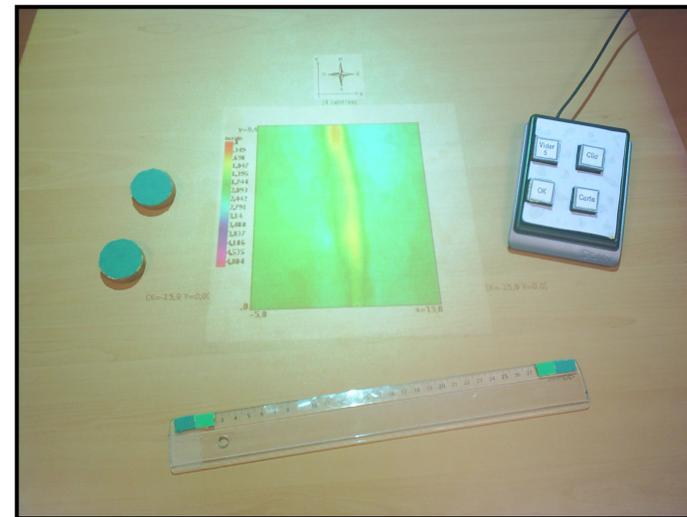
Perspectives

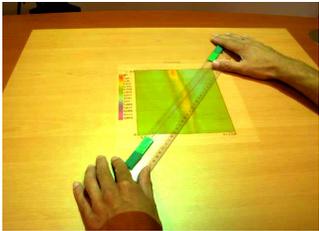
- Implémenter
 - Edition des courbes
 - Attribuer des propriétés
 - Simulations dans les réservoirs
- Etudes utilisateur
 - Travail à plusieurs

Merci de votre attention.



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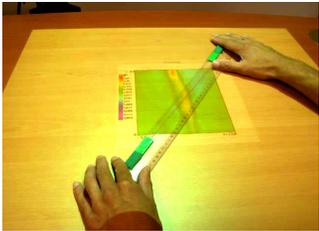
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Definitions

- Characterization of input devices
 - Time-multiplexed input
 - « one device controls different functions at different points in time »
 - Space-multiplexed input
 - « each function to be controlled has a dedicated transducer »



Fitzmaurice, Ishii, Buxton, 95,96,97



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Definitions

- Characterization of input devices

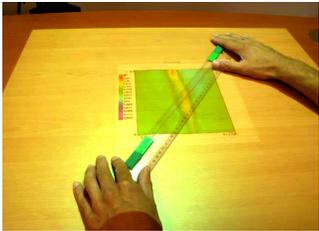
- Generic form / Specialized form

Fitzmaurice,
Buxton, 96, 97

« specialized form when it roughly matches the shape and manipulation characteristics of the logical controller »

- Cutting line selection task

		Multiplex	Form
GUI	Mouse	<i>Time</i>	<i>Generic</i>
TUI	1-Puck	<i>Time</i>	<i>Generic</i>
	2-Puck	<i>Space</i>	<i>Generic</i>
	Ruler	<i>Space</i>	<i>Specialized</i>

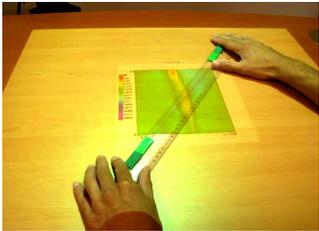


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Fitzmaurice's hypothesis

- Manipulating physical/logical
 - (H1) Multiplex: Space > Time
 - (H2) Form: Specialized > Generic (in space-multiplex conditions)

	H1	H2	
Match a series of target Fitzmaurice 96 Chap 6.1	✓	✗	Spec. ~ Gen.
Ex1: Perform a series of six cutting planes	✓	✗	$R \sim 2P$ 5% speedup
Ex2: Recognize a letter	✓	✓	$R > 2P$ 18% speedup 133% performance gain

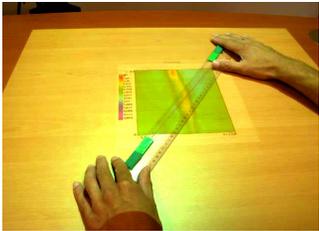


Specialized vs. generic devices

« Just as the additional physical constraints in the tower of Hanoi/oranges/tea cups task helped the user with mental problem solving, the physical constraints in the ruler and stretchable square help the users physically maintain these relationships that exists between the dimensions of the virtual and real rectangle being drawn »

Fitzmaurice 96
Chap 6.1

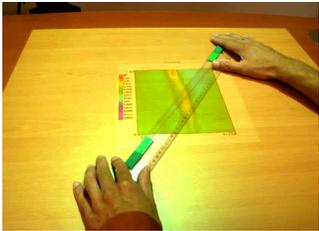
- A series of simple tasks ✘
 - Match a series of target
 - Perform a series of six cutting planes
- A composed task ✔
 - Recognize the letter hidden in the cube



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Conclusion

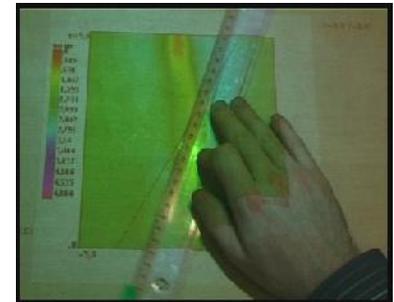
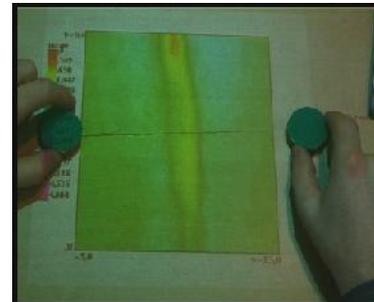
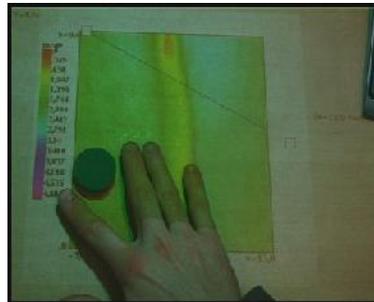
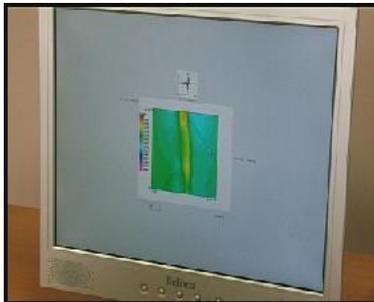
- Tangible UI on a tabletop for geoscience
- Mobile hardware setup for TUI on a Tabletop
- Two user experiences
 - Adhesion of the geophysicists
 - The choice of the ruler is justified for the cutting line selection task
- Specialized devices perform better than generic ones for composed tasks



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Results

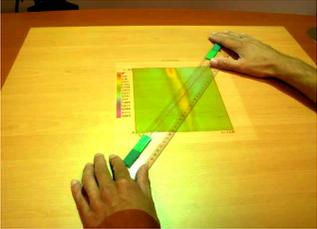
- Temps moyen de manipulation des utilisateurs



– Ex1 :	26s	52s	23s	18s
– Ex2 :	8s	18s	7s	5s

- Différence des moyennes entre *2P* et *Règle* :

- Ex1 : test-t pairé $t=1.13$ (df=11) **N.S.**
- Ex2 : test-t pairé $t=3.30$ (df=11) **$p<.004$**



Conclusion

- Choix d'un interacteur tangible pour la sélection d'une ligne de coupe.
- Nous prouvons statistiquement que la règle améliore l'interaction comparée à la souris, 1-palet, et 2-palets.
- L'hypothèse 2 de Fitzmaurice 96 Chap 6.1 est validée dans le cas de tâches composées.

