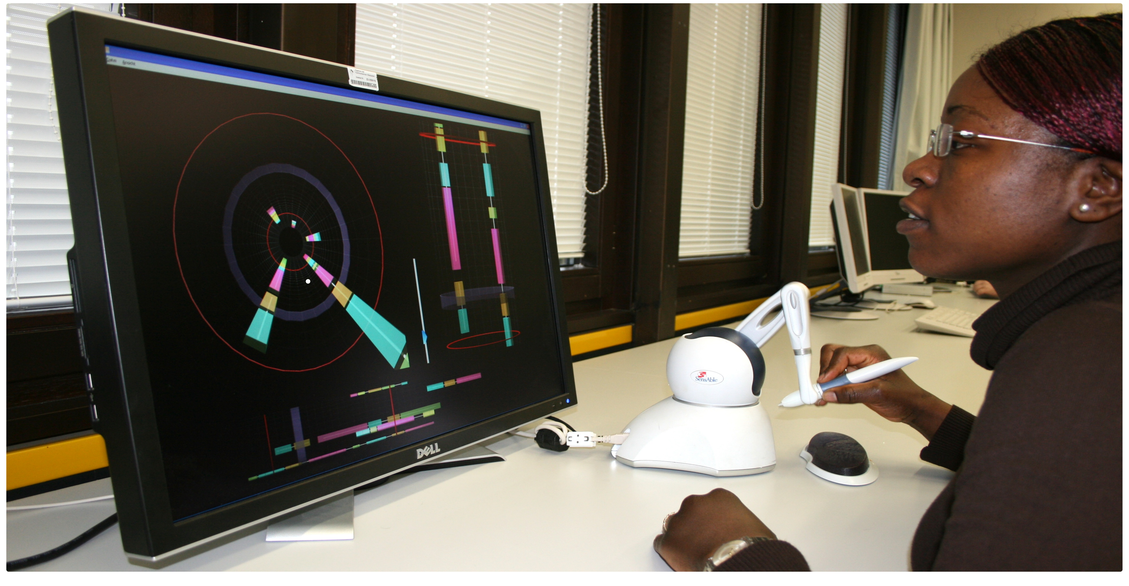
TimeTube: A Haptic 3D Visualization Technique for Assisting Laboratory Staff in Scheduling Tasks

Johannes Luderschmidt, Fabio Campos, Jörg Gutmann, Ralf Dörner, Reinhold Schäfer Wiesbaden University of Applied Sciences
65197 Wiesbaden, Germany, Kurt Schumacher Ring 18, Phone: +49-611-9495-201, Fax: +49-611-9495-210, Email: timetube@informatik.fh-wiesbaden.de

Fachhochschule Wiesbaden
University of Applied Sciences

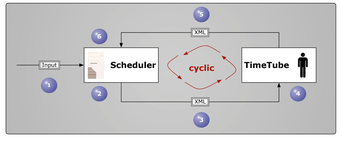


- Haptic visualization technique allows laboratory staff to grasp computer-generated schedules more efficiently
- Haptic user interface makes schedules easy to manipulate - facilitating the combination of human knowledge and computing power to solve sophisticated scheduling tasks in lab automation

Overview

- Goal: Increase efficiency of scheduling processes in Life Sciences' experiments
- Characteristics of experiments with living organisms:
  - Variable duration of activities
  - Environmental influences to testing procedures
- Consequences: Scientist's expertise is crucial for efficiency of decision process in scheduling
- Provision of expertise is facilitated by novel human computer interface:
  - Dedicated 3D visualization technique allows understanding of schedule
  - Dedicated 3D interaction technique allows manipulation of schedule
- Haptic interface device supports visualization and interaction

Process description

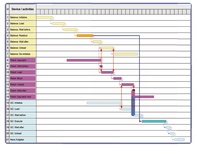


TimeTube embedded into existing workflow:

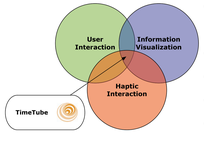
1. Several workflows as an order for scheduler
2. Schedule workflows
3. Pass resource instance specific activities to TimeTube (XML file)
4. Scientist rearranges activities' execution times and/or resource instances in TimeTube
5. Send rearranged data back to scheduler (XML file)
6. Calculate schedule with additional constraints

TimeTube ⟷ Gantt chart

- Gantt chart: visualization commonly used for planning time related activities and visualizing their dependencies
- Workflow may consist of activities with very long and short activities
- Due to linear nature of Gantt charts difficult to keep an overview



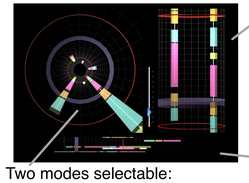
Source: Schäfer, R., Concepts for Dynamic-Scheduling in the Laboratory, JALA, December 2004, Pages 382 - 387



- TimeTube combines findings of…
- … information visualization
- … user interaction
- … haptic interaction
- Goal: Better usability

TimeTube visualization technique

- Activities and workflows displayed in a tube
- Visual representation:
  - Activities – boxes
  - Same color – same workflow
  - Z-axis – time
  - Point in time – tube cross section – circle in main view
  - Front – future; back – past



- Two modes selectable:
  - Ressource view
  - Workflow view

- Activities highlighted in case of constraint violations
- Detail information via pop-up window

- **Side view** presents dynamic in-tube view
- Side view shows cut-out of tube's wall at current position
- Cut-out orientation modifiable by simply rotating a pen
- Side view supports detail navigation
- Gaps between activities are better visible

- **Context view** offers view onto TimeTube from outside
- Clicking onto tube in context view allows fast scrolling to a certain point in time

Haptic interaction

- Simple interaction with TimeTube using Phantom Omni
- The Phantom Omni offers:
  - exertion of forces for giving feedback to the user, e.g. for showing constraints
  - identification of 3D pose of the pen mounted to the device
- Phantom provides means for reallocating activities' execution time and resource instances
- Phantom used for scrolling on time axis
- Phantom force feedback utilization:
  - Constraints tube
  - Indicates activity movement
  - Indicates scrolling speed during movement along the time axis

Prototype

- Quest3D used for visualization
- Haptics Library API in C++ used for Phantom interaction implementation