An unified in-field measurement and alignment software for experiments and accelerators at CERN large scale metrology section.

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Content

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  • Coordinate systems
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  • Different views of the data

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  • Workflow
  • Architecture

• Status of the development
  • First iterations
  • Next iterations

• Summary & Outlook
CERN complex alignment - geodesic measurements

- Theodolites, tachometers, trackers and reflectors
  - Angles
  - Distances
- Levels and staffs
  - Offsets to horizontal planes
- Ecartometers
  - Offsets to vertical planes
- Tilt sensors
  - Inclinations
## In-field acquisitions - Divergences & similarities

### Measurement
- **Repetitive**
- **Diversify**

### Tolerances
- **Well-defined**
- **Variable**

### Sequence
- **Controlled**
- **Non-existent**

### Main user
- **Industrial Support**
- **CERN STAFF**

### Coord. System
- **Global**
- **Local**

### Most processing
- **Postpone**
- **Immediate**

### Business model
- Elements, points, networks, geodetic measurements, ...

### Instrument
- Communication librairies

### Calculation
- Survey Software dependencies
Main drawbacks

- From 90’s, in VB6 and VBA
- GUI are French only
- Not “touch screen” friendly
- Maintenance
  - New instruments + computing libraries replacement
    >>> double implementation
  - Performed by several surveyors
    >>> duplicate parts + Procedural and OO programming

≈ 600 lines

14 levels of conditional statements

The challenge

- Unify survey data acquisition tools;
- Facilitate the maintenance;
- Open doors to more up to date interfaces.

Rewriting of a single application that fulfil all the constraints
Constraints

Use cases - Multi-user mode

- Dependencies
  - Coordinate systems
  - Environment of use
  - Data Views

Advanced user
- Flexibility

Guided user
- Controlled step by step procedures

Use cases:
- Multi-user mode

Dependencies:
- Coordinate systems
- Environment of use
- Data Views

Advanced user features:
- Theodolite Measurement
- Tilt measurement
- Levelling measurement
- Ecartometry measurement
- Magnet alignment
- Tour d’horizon
- Magnet pre-alignment
- Implantation 3D
- Altimetric pathway
- Radial smoothing

Guided user features:
- Instrument reading
- Station Setup
- Export
- Import
- Geode db
- PcTopo32
- Report s

Advanced user advantages:
- Controlled step by step procedures

Guided user advantages:
- Flexibility

TSUNAMI
Constraints

Use cases - Multi-user mode - Dependencies
Coordinate systems - Environment of use - Data Views

- **Base de données Geode**
- **Calculations**
- **Instrument communications**
- **Transf.**
- **TSUNAMI**
- **Custom file types for exchange and/or storage**
- **Compensation**
- **Transformations**
- **Executable files**
- **Géomètres**

Dynamic libraries

Instrument communications

Calculations

Custom file types for exchange and/or storage

Compensation

Transformations

Executable files

SurveyLib.dll (Calculs topographiques)
Shapes.xlma (Ajustement paramétrique par moindres carrés)
LTControl.dll
LTVideo.dll
GeoCom32.dll
GCom105.dll
(T3000.dll (Communication théodolite)
CalcTopo.dll (Calculs topographiques)

Dynamic libraries

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Constraints

Use cases - Multi-user mode - Dependencies

Coordinate systems - Environment of use - Data Views

Accelerators

Physics experiments

CERN CS : XYZ / XYH

Physicist CS
Survey CS
Constraints

Use cases - Multi-user mode - Dependencies
Coordinate systems - Environment of use - Data Views

List  Tree  3D
Method

Development process - Platform & language - Workflow - Architecture
Method

Development process - **Platform & language** - Workflow - Architecture

- Calculations dependencies
- Instrument libs and API
- Wrappers
Method

Development process - Platform & language - Workflow - Architecture

Modularity

Framework mechanisms

Design Patterns

Reusability  Validity  Integrity  Efficiency
Extensibility
Maintainability
Interoperability  Reliability

Quality

Conviviality  Transparency  ...

Efficiency  Reliability  Conviviality  Transparency  ...
Method

Development process - Platform & language - Workflow - Architecture
Method
Development process - Platform & language - Workflow - Architecture
Method

Development process - Platform & language - Workflow - **Architecture**

**Model**
(Data)

*state change events* ➔ *updates*

**Presenter**
(TSUNAMI module)

*user events* ➔ *updates*

**View**
(GUI)

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Add an Advanced module
Add one of the following module which will give you complete freedom of use: the module, levelling, tilt or offset module, or object managers
Status of the development

First iterations
• Design Artefacts
• Prototype
  • Managers & dependencies;
  • Ecartometry, levelling & Theodolite.

Next iterations
• Architectural choices + implementation:
  • Tilt measurement;
  • Guided modules.
Summary & Outlook

2 data acquisition software >> TSUNAMI (2 user modes)

• Development in progress…
  • Global architecture delivered >> Satisfy constraints + ensure quality
  • Most core functionalities implemented

• Full-scale tests (next year)
  • CERN survey team >> feedback >> Corrections and adjustments

• First version >> next long shutdown

• Architecture + documentation >> ease the maintenance

• Achieved modularity >> stimulate extensions
  >> reuse of code in future projects.
Thank you for your attention.
Method

Development process - Platform & language - **Workflow** - Architecture

- Start tSUNAMI
- Advanced user
- Identify user
- Contractor
- Allow all module
- Allow Guided/ template Modules
- Select a Guided/ template module
- Theodolite, Ecartometry, Levelling, ...
- Alignment, Implantation, Td’H
- Need station setup
- Setup the Stations
- Measure elements
- Export and Save
- No need of setup
- Need station setup
TSU-NAMI