SmartAnALOG All Automated digital Outcrop

Enhancing reservoir characterization & modeling with outcrop reservoir analogues
Outline

1. SmartAnALOG Project
2. Acquisition of 3D outcrop model
   - State of the art
   - Benefits of our choice
   - Multiscale & multi focal acquisitions
3. Virtual Outcrop Analysis Software: VIRTUOSSO
   - The Ainsa Channel – an example of a complete workflow
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SmartAnALOG?

Objectives of the SmartAnALOG project

- 3D outcrop modelling
- Import 3D geological outcrop studies into a geomodelisation software
- Light and fast acquisition
- Moderate processing time
- Easy integration of field data
- Link with geomodelers (Petrel, Gocad)

To enhance reservoir characterization & modelling
SmartAnalog Workflow
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Acquisition: State of the Arts

**LIDAR (Light Detection And Ranging)**

The choice was obvious ...
Benefits of photogrammetry acquisition & modelisation

- Easy & fast acquisition
  - Easy: just know how to take a good picture
  - ex: Ainsa 30 minutes for ground acquisition
    1 hour for aerial acquisition (but greater coverage)

- Automatic method

- MultiScale & MultiFocal acquisition

- High Precision
  - 1 to 50 cm in relative
  - 2 to 3 m in absolute

- Low cost acquisition
  - A camera with a prime lens
  - A handeld GPS
Relative precision:
Geometry and Scale of the 3D model

Absolute precision:
Positionning accuracy of the 3D model in a cartographic reference system

RTK GPS positionning:
Y = 4699686.995
X = 759139.036
Z = 488.760

Δx = 2.36 m  Δy = 0.48 m  Δz=1.63 m
MultiScale & multi focal acquisition

Sony NEX7 – 19mm lens

Canon5D – 24mm lens

Limits of the air/ground texture
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VIRTUOSO (Virtual Outcrop Analysis Software)
Virtuoso: Virtual Outcrop Analysis software

- Polylines digitalization (illustrating geologic horizon, fault and fracture)
- Property painting (e.g. Facies)
- Strike/Dip measurement
- Distance measurement

- Polylines & Facies Export in ascii format – Easy to import in Gocad/Petrel
- Object transparency control (Display enhancement)

User Interface

Display
Outcrop interpretation

- Horizon picking

- Litho-units definition
- Export in geomodel
  - Surface construction
  - To build the reservoir grid
Outcrop interpretation

- Property painting (facies)
Outcrop interpretation

- Fracture picking & semi-automated recognition
Model construction

**Geomodel**

1. Bounding horizons picked directly on the 3D outcrop model

2. Surfaces reconstructed from polylines and structural dips

3. Pointset extracted from the photogrammetric model

4. Geological grid built from the surfacic model

**Geostatistics**

1. Computed from data interpreted on outcrop, directly from the interpretation (exported cloud of points)

2. Variograms are computed from the facies pointsets

3. Vertical proportion curves and matrix of proportion computed from local VPC for each unit
Geological modelling

Objectives: Compare models using conventional dataset and 3D outcrop interpretation

- Pseudo 1D dataset
  - 3 pseudo-wells with facies interpretation

- Fully interpreted outcrop

VS
Geostat. parameters – Heterolithics

Full outcrop

Pseudo-wells

- Pointset

22300 points

8400 points

Horizontal variograms

- 2 ranges corresponding to the outcrop configuration (channel bottom confinement)
- Ranges difficult to interpret
- Picks corresponds to pseudowells
Results

Dataset: pseudowells vs. outcrop interpretation

- Full outcrop interpretation
  - Continuous dataset
  - Heterogeneity continuity well represented

- Pseudo 1D dataset
  - 4 pseudowells with facies interpretation
  - Very smoothed facies distribution
  - Heterogeneity continuity poorly represented
SmartAnALOG video