3D Cadastre Developments in Hungary

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Knowing to manage the territory, protect the environment, evaluate the cultural heritage
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Hungary
- Area: 93 000 sqkm
- Population: 10 million
- Cadastre & Land Registry:
  - No. Of Parcels: 7.6 million
  - No. Of Properties: 10 million
Hungarian Land Administration

- Ministry of Public Administration and Justice
  - Network administration supervision of Land Offices

- Department of Land Administration at Ministry of Rural Development
  - Overall professional supervision of LA Sector

- National State Holding Company
  - National Cadastral Program Ltd.
    - Financial management
    - Ownership of Cadastral Map Databases

- Ministry of National Development
  - First level authority in LA cases

- 19 County Land Offices + Land Office of the Capital
  - County level supervision of District Land Offices
  - Second level authority in LA cases
  - Planning and coordination

- District Land Offices (119)
  - Daily updating of unified Land Registry
  - Cadastral mapping
  - Land valuation, land protection, land use
  - Data service
  - First level authority in LA cases

- FOMI
  - R+D activities
  - Support of Land Offices
  - Operation of TAKARNET
  - Topographic mapping
  - Remote Sensing activities
  - State Boundary Survey
  - Quality Management
  - Satellite Geodesy

The Unified Hungarian Land Registry

- In Unified Land Registry Cadastral Mapping and Registration of Lands (Properties) belong to the same organization: Land Office Network
- Unified Hungarian Land Registry has been operating since 1972
- Unified Hungarian Land Registry is a Title Registry, all registered rights are guaranteed by the State
**Legal Framework**


Unified Land Registry

New Act on Surveying and Mapping Activities (2012)
- Traditional Paper Maps → Databases (including Remote Sensing, DEMs, LiDAR etc.)
- Unified Land Registry Database (Cadastral Maps + Land Records)
- 3D Cadastre:
  "Under-ground and above-ground passes objects, structures, which has homogenous ownership and/or handler relationships should be taken into account as an independent property, which must be registered in Land Registry."

New Act is accepted by the Hungarian Parliament on these days
New Act come into force at the end of October 2012, except 3D Cadastre rules, which will come into force in July 2013
Implementing rules and guidelines should be elaborated till these deadlines

**Legal Spaces in 3D Cadastre**

Peter van Oosterom and Rod Thomson have elaborated an axiomatic definition of 3D parcels (3D Cadastre Workshop 2011, Delft, The Netherlands)
Homogenous coordinates and infinity

Euclidean (Affine) space

Projective space

Plain at infinity

Plain at infinity

\((X,Y,Z)\)

\((X,Y,Z,1)\)

\((X,Y,Z,0)\)

Homogenous coordinates and infinity

Plain at infinity has no any special role in projective space as in Euclidean (Affine) space. Therefore unbounded legal spaces are not existing anymore, because plain at infinity closes these spaces.

Principle of Duality in projective space:
Every definition remains significant, and every theorem remains true, if „point” and „plain” are exchanged
„3 points determines one plain” -> „3 plains determines one point”

Lines, plains and direction

Coordinates of a plain

\[ \begin{vmatrix}
  x_1 & y_1 & z_1 & 1 \\
  x_2 & y_2 & z_2 & 1 \\
  x_3 & y_3 & z_3 & 1 \\
  x_4 & y_4 & z_4 & 1 \\
\end{vmatrix} = 0 \]

Space partitioning by lines or plains

Scalar product of point with a line:
+ left, - right

Scalar product of point with a plain:
+ above, - below
**Polygons and tetrahedrons**

**Faces and edges (2D)**

**Faces and infinite lines (2D)**

**Definition of a convex face**

\[
\begin{bmatrix}
X_1 & X_2 & X_3 & X_4 \\
Y_1 & Y_2 & Y_3 & Y_4 \\
W_1 & W_2 & W_3 & W_4 \\
\vdots & \vdots & \vdots & \vdots \\
X_n & Y_n & W_n & \end{bmatrix}
\begin{bmatrix}
x_1 \\
x_2 \\
x_3 \\
x_4 \\
x_n \\
\end{bmatrix} \geq 0
\]

- \(X,Y,W\) – the coordinates of a line bounded the face
- \(x,y,w\) – are the coordinates of any point within the face

**Tesselations**

**Constrained Delaunay triangulation** (in 3D decomposition of space to tetrahedral meshes)

**Advantages:**
- Optimal and unambiguous
- Automatizeable

**E.g.:** Face „A“ is a composition of R,S,T,U,VW triangles
Tessellation and infinity

Projective space

Plain at infinity

Euclidean space

Connection between 2D and 3D

Splitting tetrahedral mesh by any plain results a triangle network, and lines inherit their direction from the direction of plains of tetrahedral mesh splitted by the plain.
Implementation

DATR, IT system of the Unified Land Registry
Developed by FÖMI an bloc
Data Model acts as a country profile in LADM

Conclusion

• New legislation on Hungarian Cadastre has established the opportunities for future development of Cadastre

• Modeling of 3D Cadastre geometric situations has not been solved yet completely, but there are promising results

• Utilization of homogenous coordinates and projective space in 3D Cadastre modeling is at the very beginning, but it seems that could be a useful solution
Thank you for your attention

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