VISCO: Bringing Visual Spatial Querying to Reality

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• The Visual Language VISCO
• The VISCO Prototype
  • Architecture
  • Graphical User Interface
    • Representing, Compiling and Executing Queries
      • Abstract Syntax Graph (ASG)
      • Optimizing Compiler (Petri Net Model)
• Example (Quicktime Movie)
• Conclusion
VISCO: Vivid Spatial Constellations

**Basic Key Concepts**
- Represent constellations (aggregates) of geometric objects
  - Describe classes of pictures through pictures, represent spatial aspects *directly*
    - adequacy, consistency, transparency
- Extensions
  - VSQL: retrieve from spatial DB
- Geometric objects
  - Transformable aggregates with local coordinate system, polygons & polylines, segments, points
- Guidance of interpretation of visual aspects present in a VISCO definition
  - Physical metaphors
  - Meta objects
- Expressive: metric, geometric and topologic relationships / constraints
  - inside / contains, disjoint, intersects

**Some Quadrilaterals**
Degree of Vagueness can be seen ("Mental Animation")

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VISCO: Overview of Language Elements (Incomplete)

Marble  Nail  Origin

Beam  Antenna  <=-Antenna  >=-Antenna  Rubberband

Constant Encl.  Inner Encl.

Outer Encl.  Epsilon Encl.  Inner Epsilon  Outer Epsilon

Lake
Thematic Descriptor

10 ... 100 m
Size Indicator

5
At Most Constraint

Scaling

Arrow & Scale

Transparency Film
Example Query: How to Find a BBQ Place with VISCO

Requirements for BBQ Place

• If you don’t own a car, it must be in the vicinity of a subway station, we don’t want to walk much more than approx. 800 meters
• We would like to sit at a pond
• If it is a hot or rainy day, it would be good if there were some trees to protect us
• However, only foliage trees are suitable

Distinguish explicit and implicit composite objects!
The VISCO Prototype: Logical Architecture

Graphical User Interface (GUI)

- Motivate
- Construct
- Validate
- Inspect

Graphical Query Editor
Animator
Execution and Result Inspector
Normalizer (Inference Engine)
Optimizing Compiler

Data Dictionary (Meta Data)

ASG (Abstract Syntax Graph) Repository

Interface to Spatial DB External View

Currently not implemented:
- Animator
- Normalizer (Inference Engine)

Spatial Database or GIS
VISCO GUI: The Graphical Query Editor

Query Editor

Working Area

Buttons

Objects

Operators

Infos

Query Construction History

Command Line

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## Representing Queries

### Abstract Syntax Graph (ASG)

- Directed multi-hypergraph with attributed edges
  - Properties (unary)
    - “has-thematic(x)”
  - Edges (binary)
    - “direct-part-of(p,l)”
  - Hyperedges (tenary, ...)
    - “intersection-point-of (p,l1,l2)”

- ASG maintained by operator applications provided by the repository module
  - Preconditions
- Graphical query editor maps user’s interactions to internal ASG operator applications
  - History of operator applications
Compiling & Executing Queries

Plan Generation

- Use ASG to construct an execution plan
  - Order of sequence of node processing (currently, simple Backtracking)
  - Binary inverse constraints: multiple plans become possible, potentially $n!$
  - Optimizer: find best plan by valuation
- Query objects
  - Searchable, use indexing, especially spatial indexing
- Universal objects
  - Must be constructed (components or operator arguments already instantiated)
- Geometric objects & enclosures
  - Spatial selection possible
    - e.g. use R-Tree

Compiler: Petri Net Model

Possible Plans: D1 - Lake - E2 - Road

Plans: D2 - Road - E1 - Lake
Current State of Work, Conclusion & Future Work

• VISCO prototype places additional restrictions on the (query) language VISCO
  • E.g., transformations must be uniquely determinable
  • E.g., for an universal arbitrary scalable and rotatable transparency film at least 3 non-collinear instantiatable nails are needed
• Optimizer: use more knowledge
  • Much more heuristics need to be included
  • Exploit database statistics as well as properties of spatial relations
• Missing components / modules
  • Animator
  • Normalizer / Inference Engine
    • Derive additional constraints only implicitly present, make them available for the compiler; query subsumption, reuse of query results (refine); query normalization
  • Use a “real” GIS / spatial DB
• VISCO GUI
  • Currently, too abstract for end users
  • Not evaluated yet
• However, the usefulness of the visual language VISCO has been proven