OPTIMIZATION TOOLS AND BIM: A MARRIAGE WITH A FUTURE?

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Alfredo Soeiro, João Poças Martins and Adeeb Sidani

University of Porto

Situation

- Design's efficiency
- Optimization algorithms
- Meta-heuristic
- Multiple objectives and mixed variables
- Linear and nonlinear constraints
- Performance, geometric conditions and material choices
- Objective function plus constraints
- Gradient based
- Search and stabilize

BIM

- **BIM is the acronym that started as Building Information Model, then Modelling and currently Management.**
- **Digital Twins**
- **Quantity surveying, design clash conflicts, planning and scheduling, safety, architectural design, structural analysis, comfort (acoustic and thermal) evaluation**
- **Visualize operations and verify compliance with regulations, norms, owner objectives, costs, and intended outcomes**

BIM (cont.)

- Store and manage information in construction
- Engineers, technicians, architects, designers, technical directors, regulators, and educators
- Facilitate access to the data in an organized manner.
- Complexity versus making proper decisions
- Decision-making and optimization tools synergy with BIM tools

Optimization methods

- System's responses and sensitivity
- Max or Min F(x) subject to G(x)
- Generally gradient based
- Planning schedules, choice of materials, design of structures and other systems, topology of elements or systems, costs or profit improvement and performance
- Neural networks, network theory, sequential quadratic programming, and interior-point methods, particle swarm optimization (PSO) algorithm ant lion optimizer (ALO), grey wolf optimizer (GWO) and mine blast algorithm (MBA)

Reflections

- Speed, robustness solution quality
- Nonlinear spaces
- Discrete versus continuous
- Acceptable vs better
- Simulation
- Evolutionary
- Imitation

Strategies and Tactics

- Cloud computing
- Data base
- Use of building information
- Access
- Structuring
- Machine learning
- Algorithms

Possible “marriages”

- **Application Programming Interfaces (APIs)**
- **Visual Programming Languages (VPLs)**
- **First case - Construction safety**
  - **Priority**
  - **Effectiveness**
  - **Cost**
  - **3D visualization**

Possible “marriages” (cont.)

Second Case - Materials

- **Legal**
- **Performance**
- **Attractiveness**
- **Execution techniques**

Third Case – Topology

- **Aesthetics**
- **Configuration**
- **Sustainability**
- **Feasibility**

Conclusions

- Customizable BIM tools
- Performance based designs
- Less need for programming skills
- APIs and VPLs
- Unlimited possibilities
- Information “rich” models with “hungry” data algorithms
- Complex designs