The 3D Studio Max plugin for simulation of the footprints on the ground surfaces

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Motivation

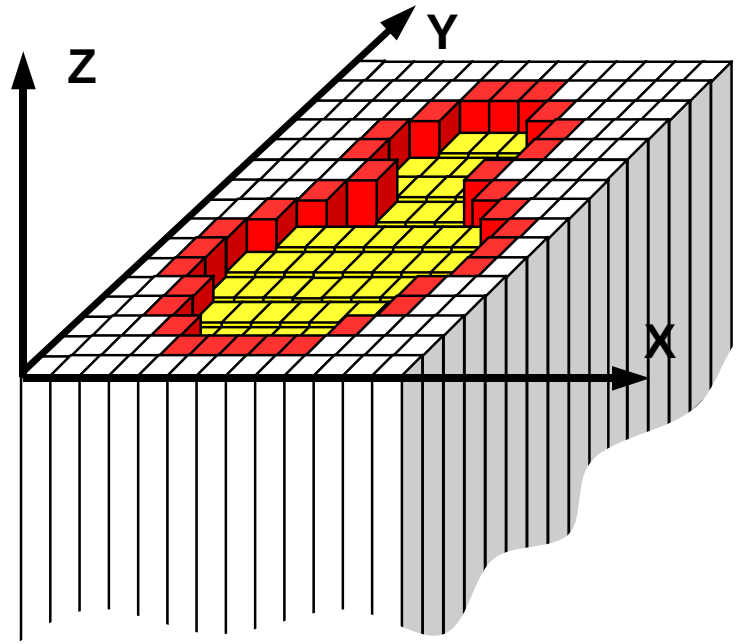
- Implementation of the algorithm for visualization of the footprints, appearing on the ground surface after the interaction with the moving object (for creation of the more realistic 3D scenes)

- Implementation of the algorithm as the plugin for some 3D modeling program (3DStudioMax), using standard instrumental tools (AppWizard, class library)

- Provision of the comfortable work with the module and its high performance during the scene visualization (usage of the adaptive representation of the object)

Algorithm basics

⌘ Model of ground material



⌘ Algorithm stages

- Collision test for affecting object (object is not necessary in mesh representation)
- Material displacement to the object periphery
- Erosion (downhill redistribution)

Algorithm description: **R.W.Summer, J.F.O'Brien, J.K.Hodgins,** ***Animating Sand, Mud and Snow****, The Eurographics Assosiation*, 1999.

Parameters

- Height field resolution

  = correct proportion between the feature size of affecting object and cell size: 4-5 cells per “feature”

- Compression ratio α

  (defines the amount of material, distributed from the affecting object to the periphery)

- Roughness (irregularity of the ground deformations) σ

  (the amount of material, moved from one cell to another during erosion)

Parameters (continuation)

- Inside and outside slopes toward the object Θ_{in}, Θ_{out}

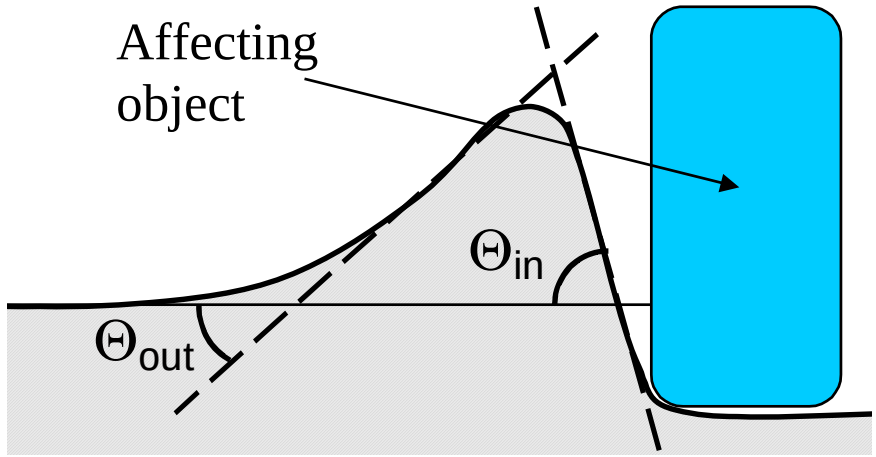
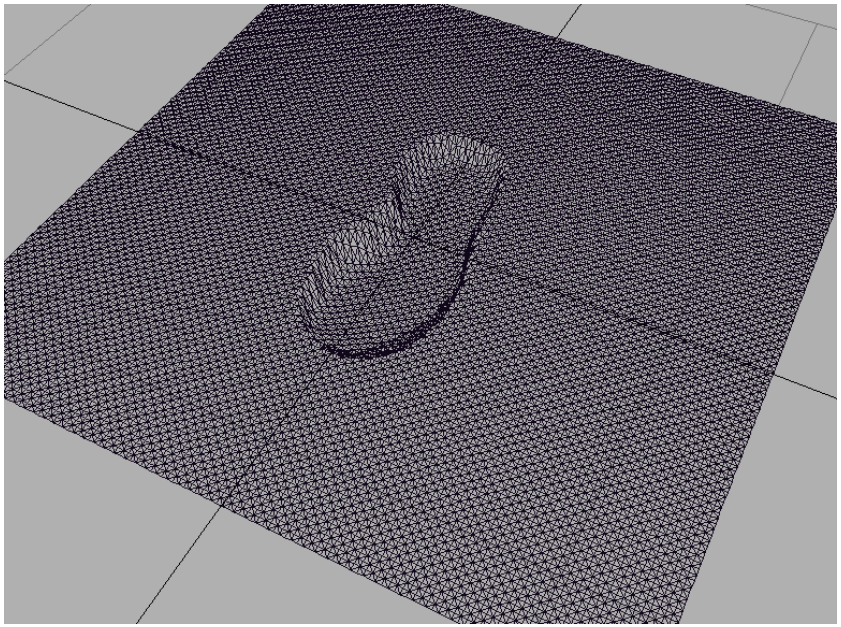


Table of parameter values for the three ground materials

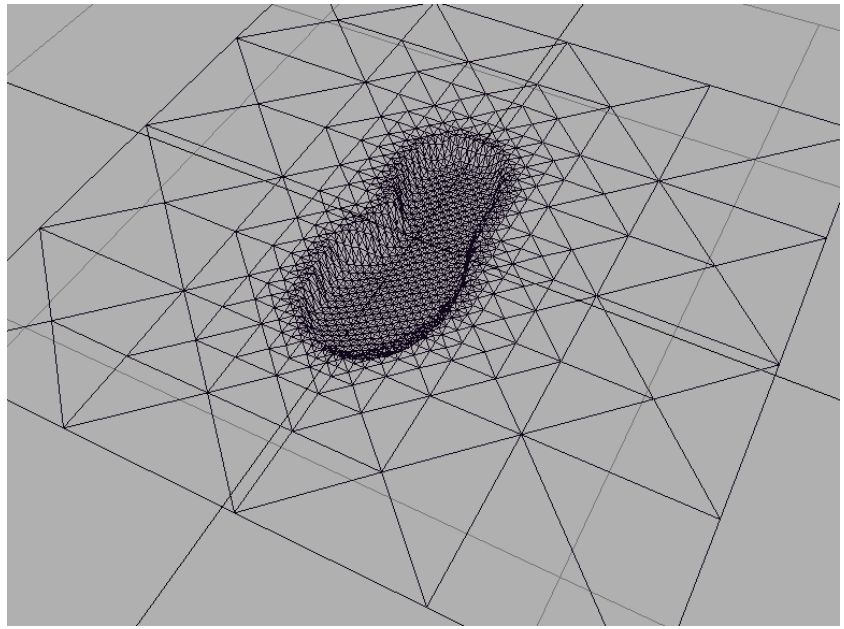
	Sand	Mud	Snow
α	0.95	0.99	0.00
σ	0.2	0.2	0.2
Θ_{in}	0.8	3.0	10.0
Θ_{out}	0.436	2.0	10.0

Usage of the Adaptive Mesh for surface representation



Without Adaptive Mesh usage

16641 points, 32768 triangles

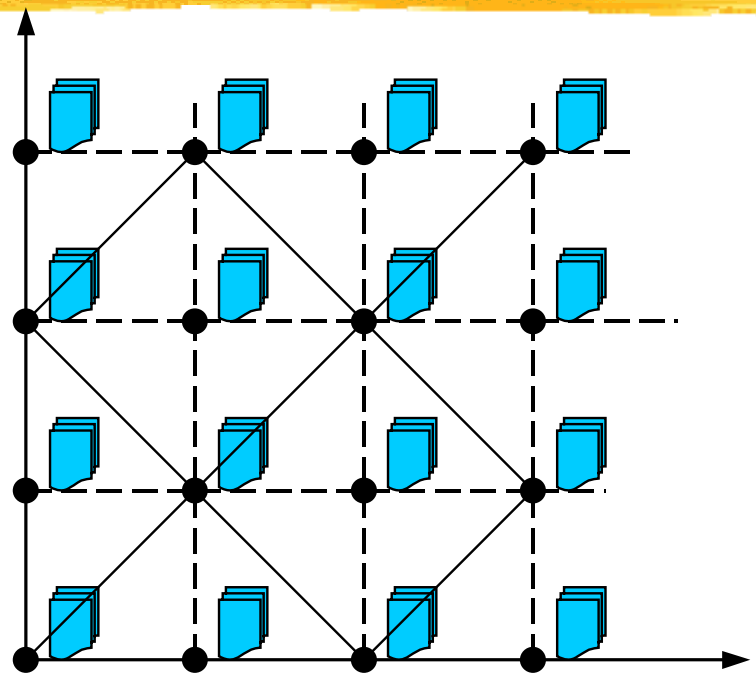


Using Adaptive Mesh

1668 points, 3318 triangles

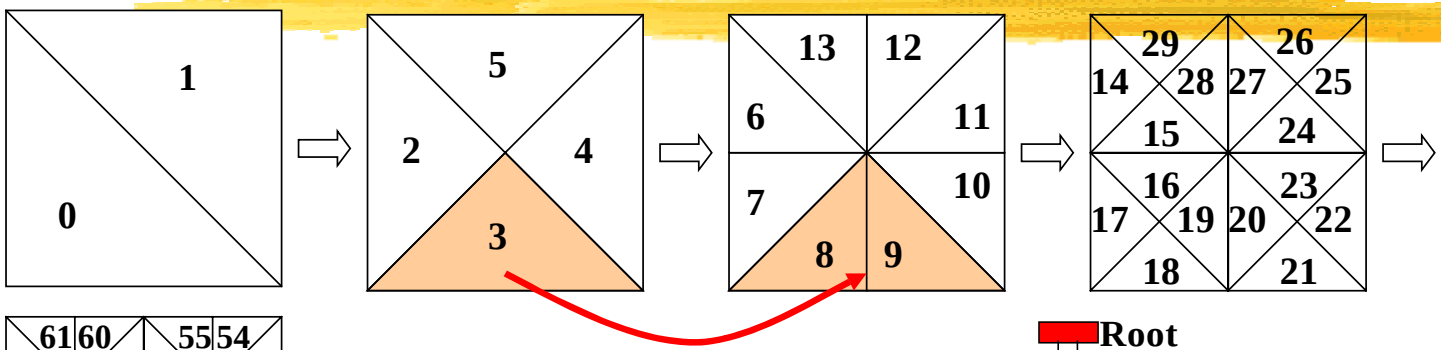
Adaptive Mesh

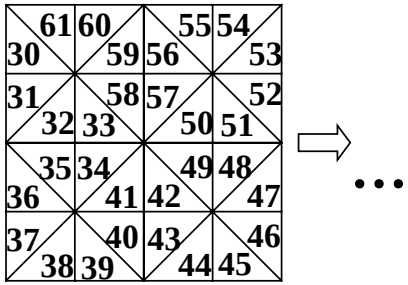
- Mesh bases on the 2D uniform grid (the most detailed mesh level)
- In every grid node user defines a set of attributes
- Based on the attribute's values, continuous level of detail mesh is extracted



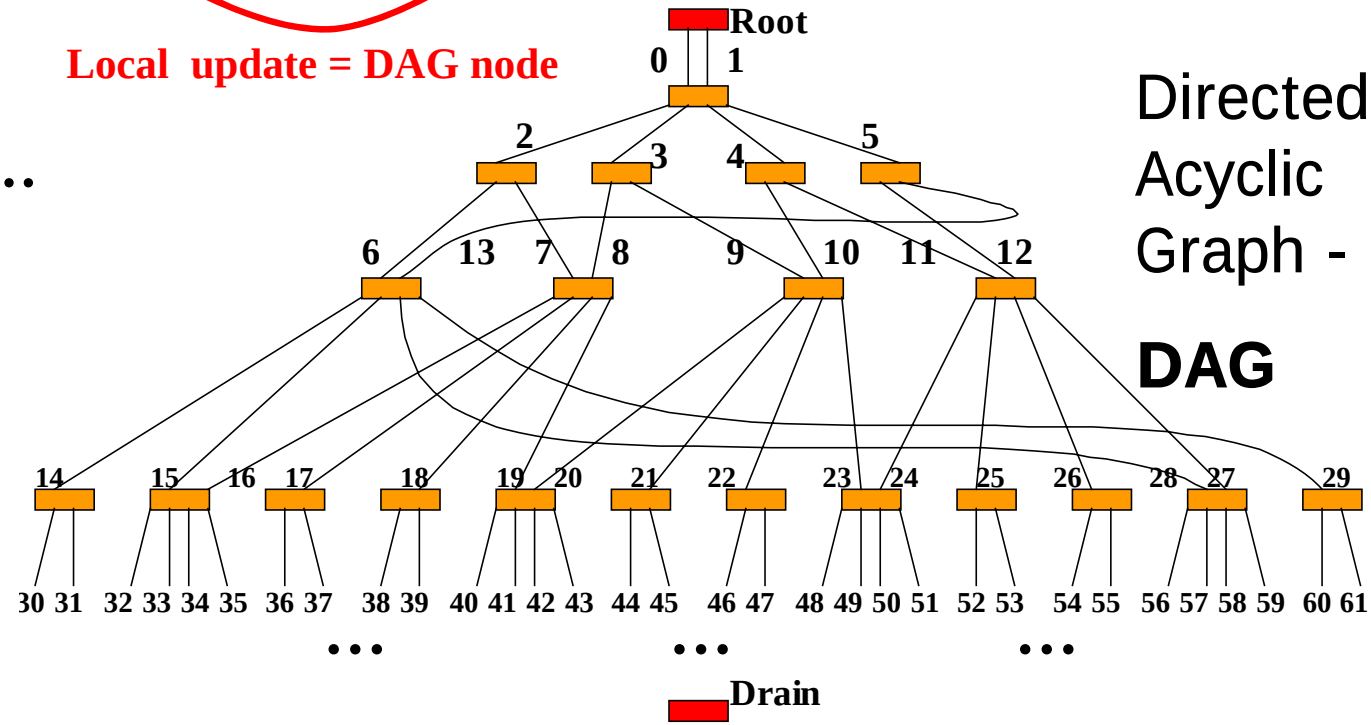
Structure of the Adaptive Mesh

it bases on the sequence of the regular local updates





Local update = DAG node

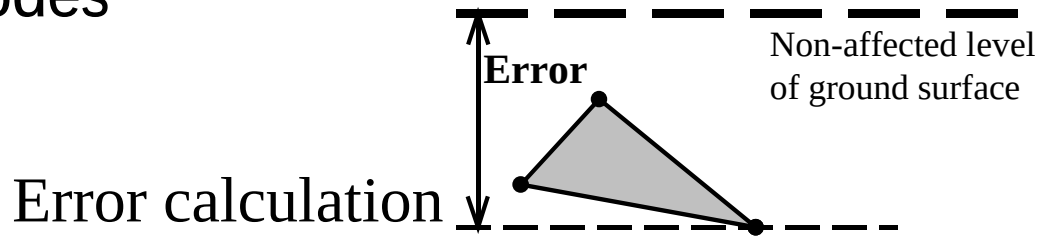


Directed Acyclic Graph -

DAG

Adaptive Mesh: surface extraction

- Every cut in the Adaptive Mesh DAG defines certain surface approximation
- Cut (surface) is naturally represented as the triangulation
- Cut is built, basing on the ***error function***, which is defined in DAG nodes

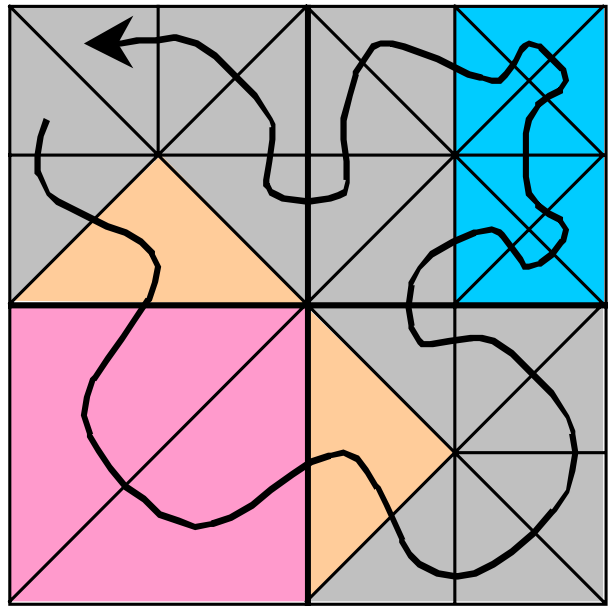


Note: directed acyclic graph (DAG) is widely used structure in multiresolution modeling

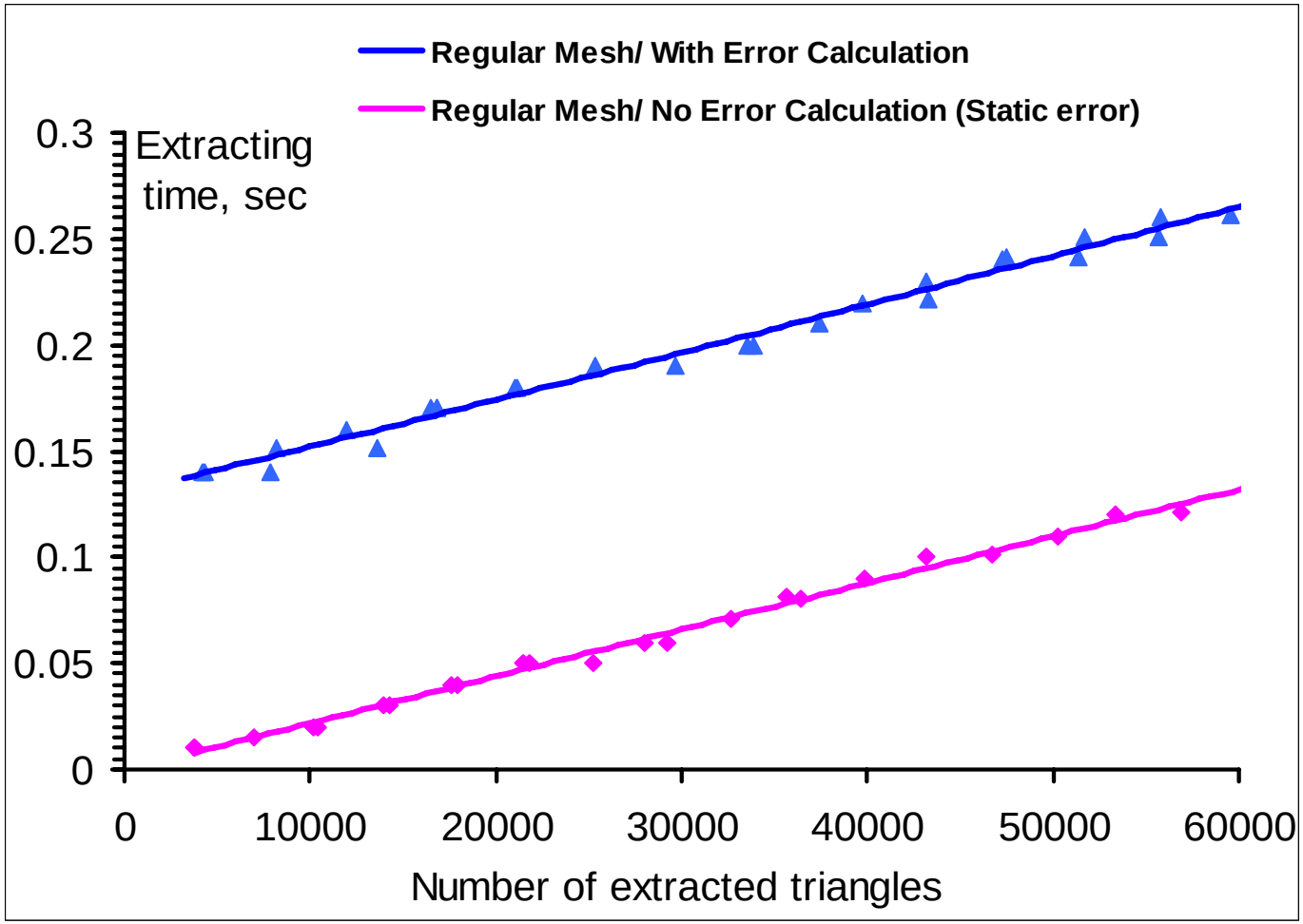
Mesh features, provided for the update's regularity

- Compact data structures ->
  - DAG creation and mesh extraction algorithms are more simply
  - Significant reduction of memory usage (more than 4 times)

- Extracting triangulation can be represented as 1 strip



Time complexity of the mesh extraction algorithm

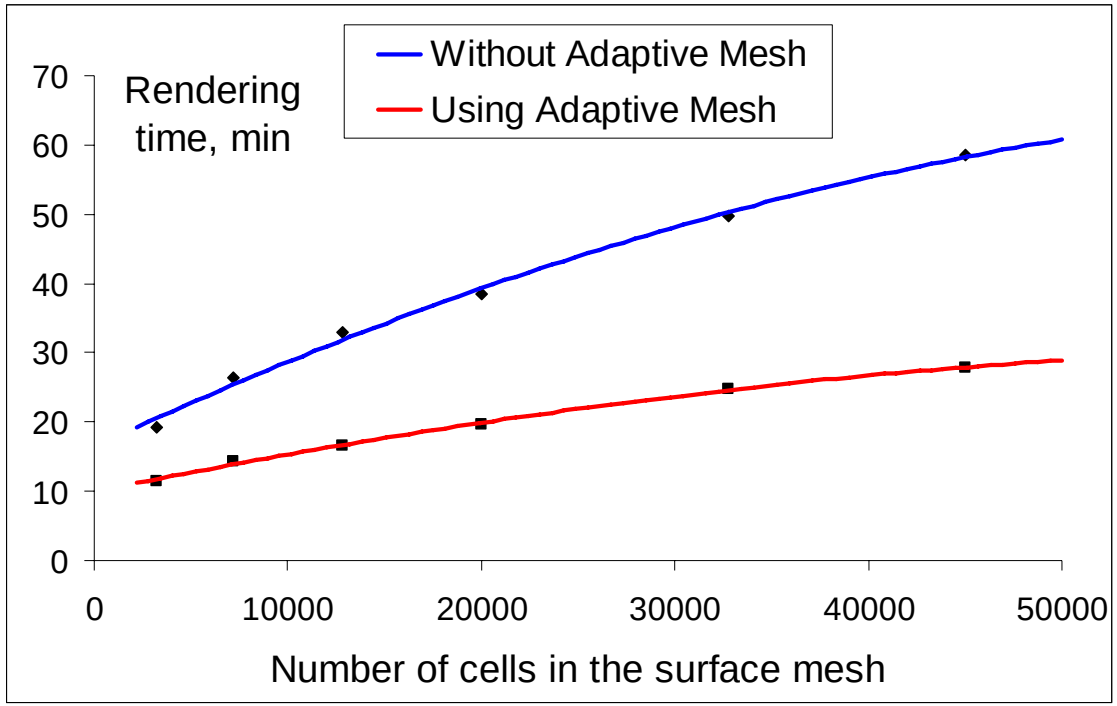


Computer:
Pentium II 400 MHz,
192 MB RAM

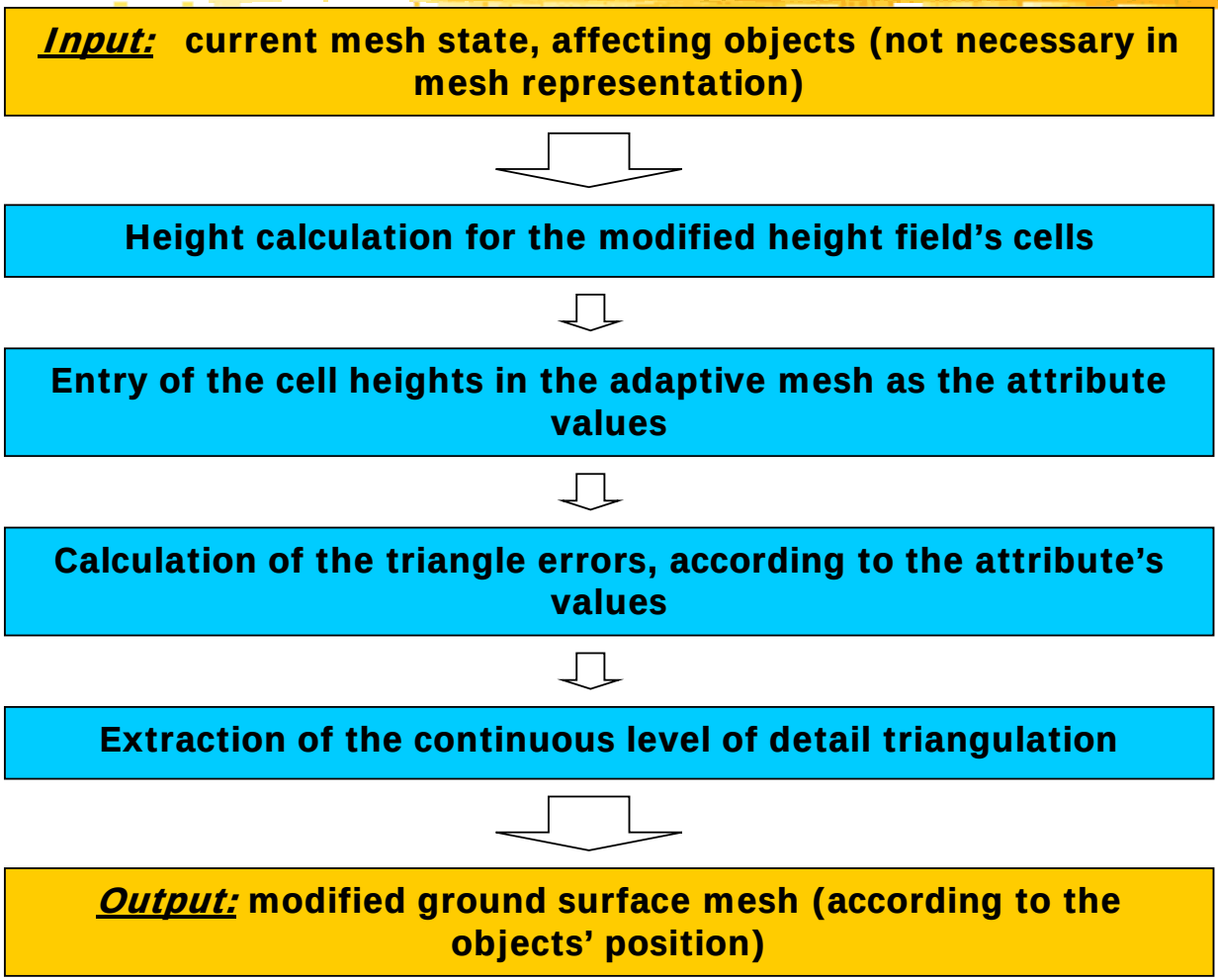
OS: Windows NT

Usage of the Adaptive Mesh in plugin allows

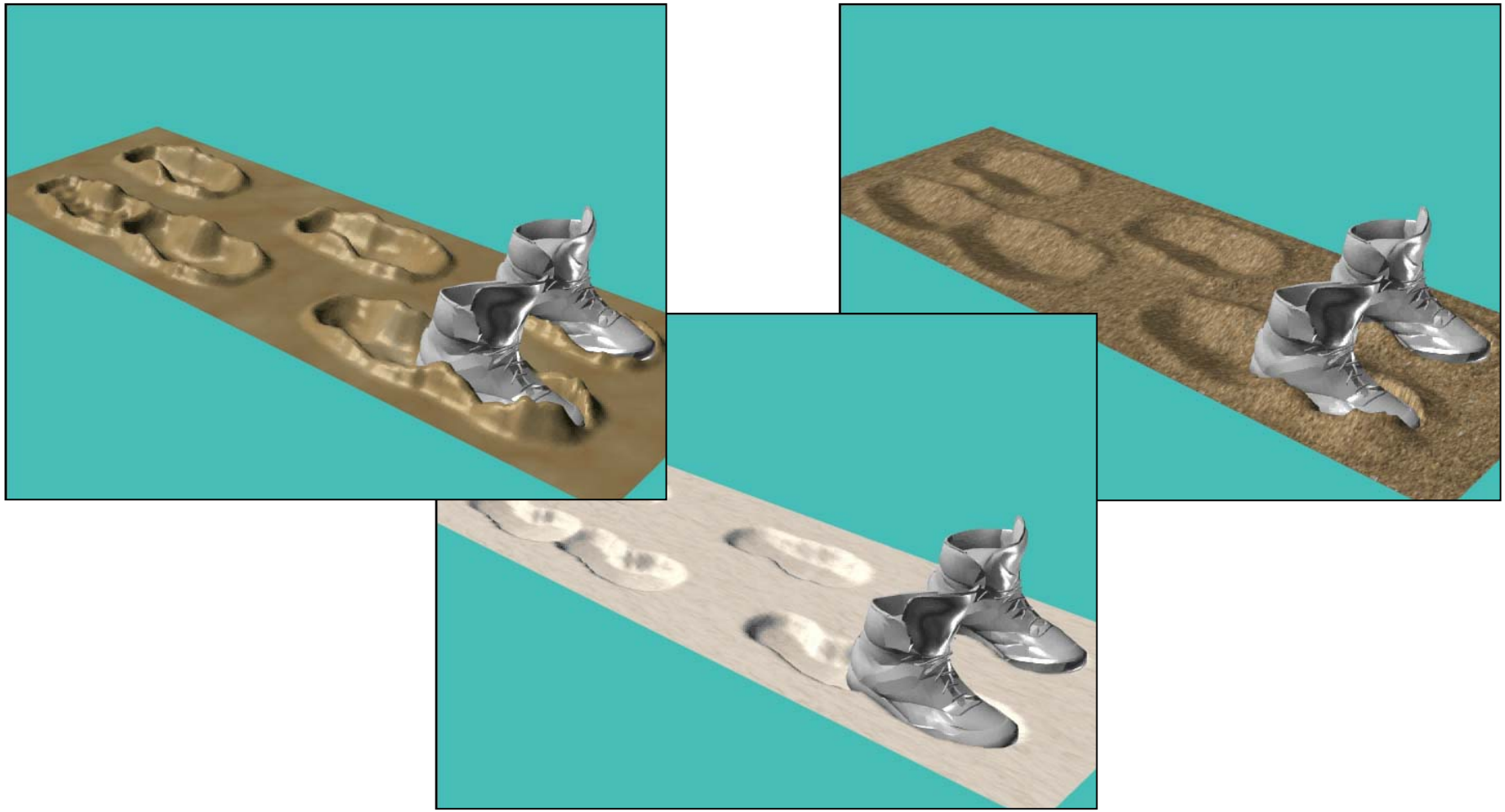
- to speed ground surface displaying in the 3DStidioMax viewports (during the scene modeling)
- to reduce memory usage for mesh storage
- to reduce time of scene rendering:



Block diagram of the algorithm



Demonstrations



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