

# Procedural Generation of Mountain Ranges based on Geology

Initial presentation

Presented by: Bernhard Fritz

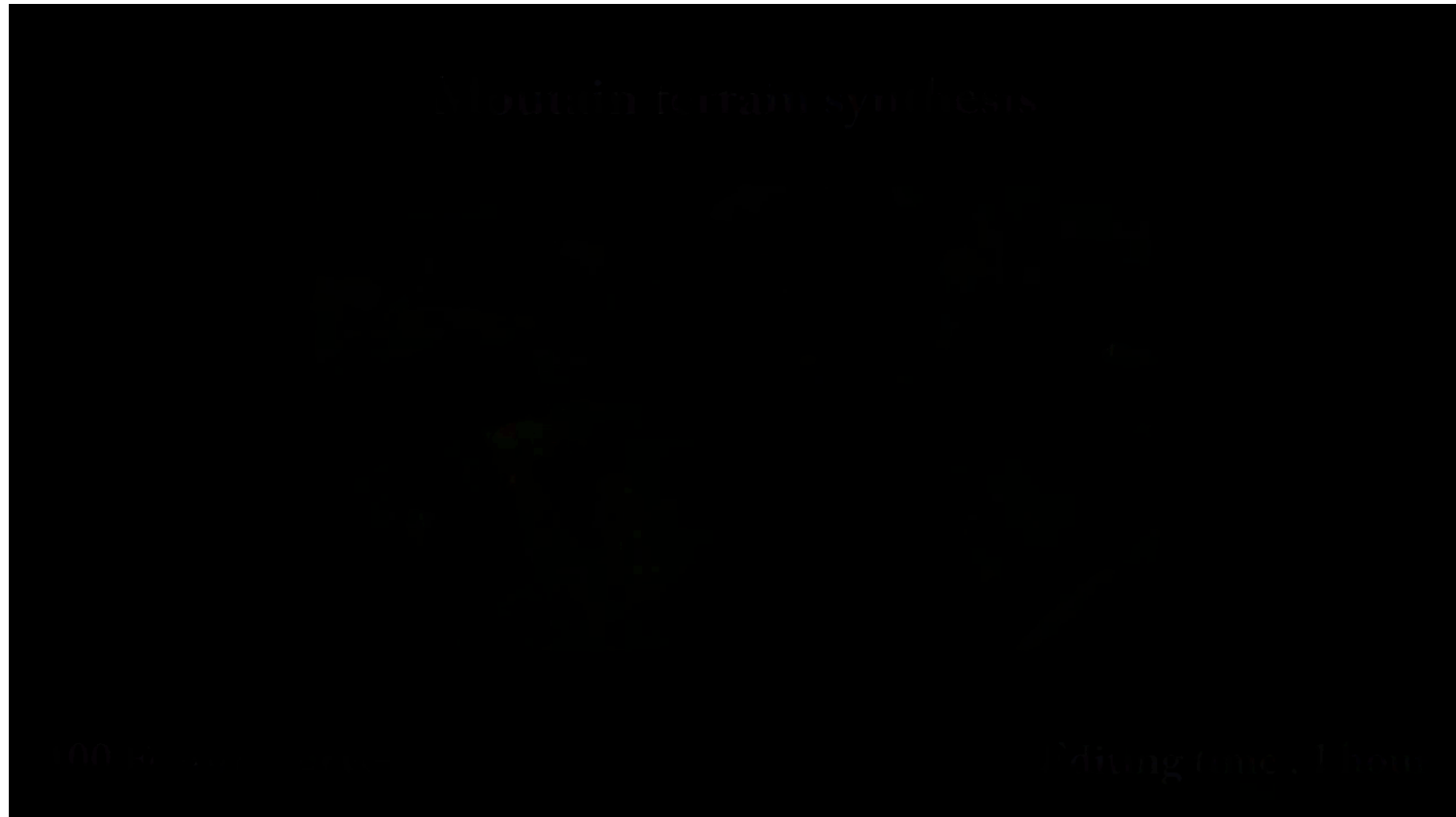
Supervisor: Univ.-Prof. Dr. Matthias Harders

Group: Interactive Graphics and Simulation



# Motivational video

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[Liris Group]

# Task description

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- Implement and test various terrain generating algorithms
- Develop an algorithm to generate mountain ranges
- Learn about how mountains originally came into existence on Earth
- Extend the algorithm based on geology

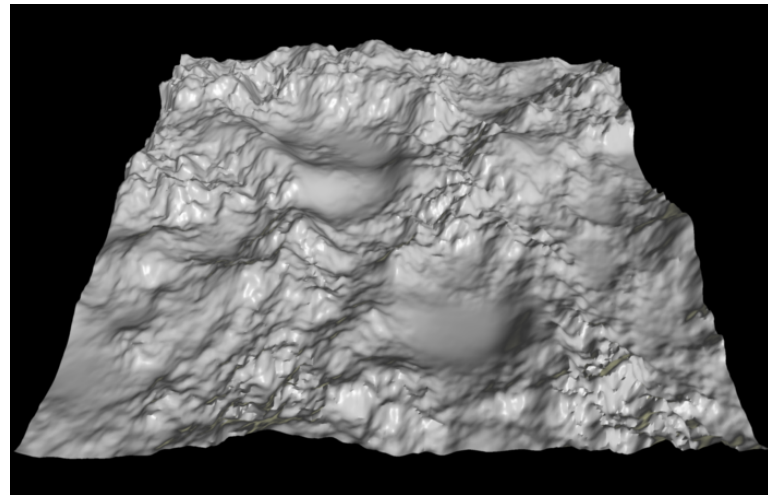
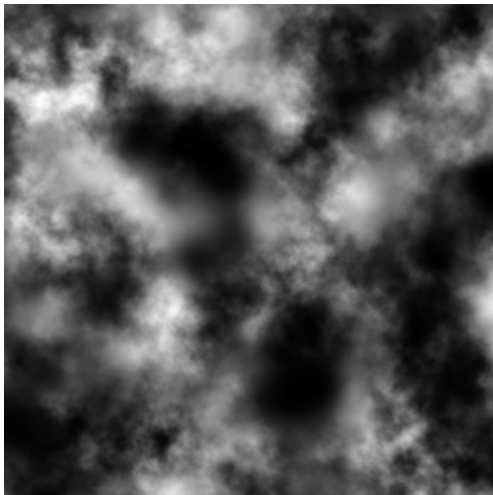
# Methods for generating mountains

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- Generation of heightmaps to encode elevation
- Basic terrain generating algorithms
- Advanced algorithms based on geology

# Generating mountains using heightmaps

- Grayscale image containing height data
- 1 byte per pixel = 256 possible height values
- $h = f(x, y)$



[Kamal, Uddin]

# Terrain generating algorithms

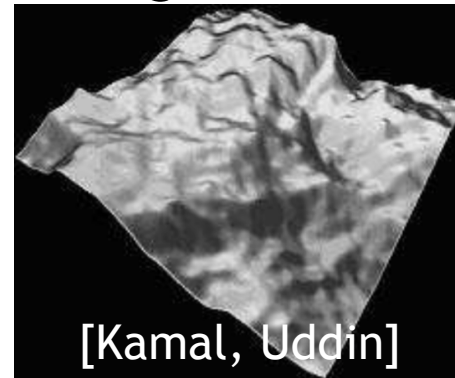
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- Midpoint displacement / Diamond-square algorithm [Fournier et al.]
- Fault algorithm [Krten]
- Repeated magnification and probing [Kamal, Uddin]

# Terrain generating algorithms

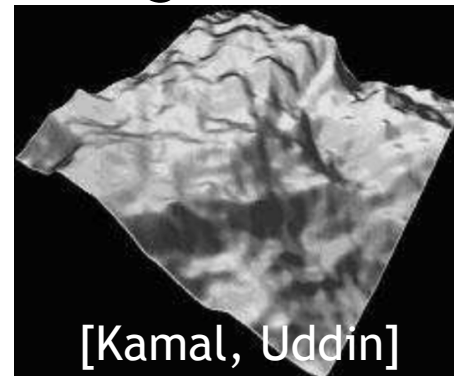
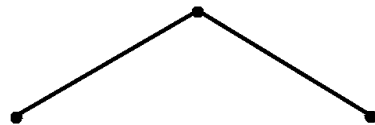
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- Midpoint displacement / Diamond-square algorithm  
while segments not too small:  
  for each segment:  
    split segment in half  
    raise midpoint by  $x \in [-R, R]$   
    divide  $R$  by 2
- Fault algorithm
- Repeated magnification and probing



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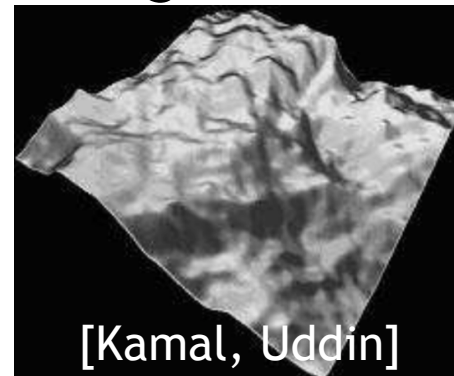


[Kamal, Uddin]



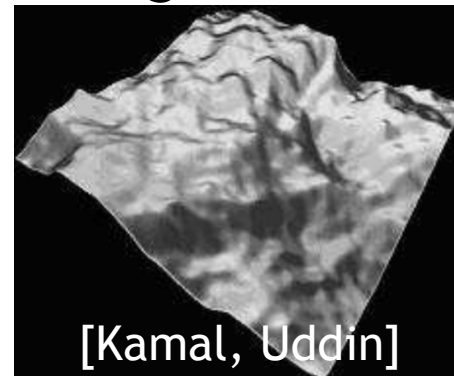
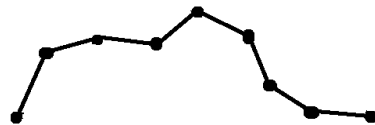
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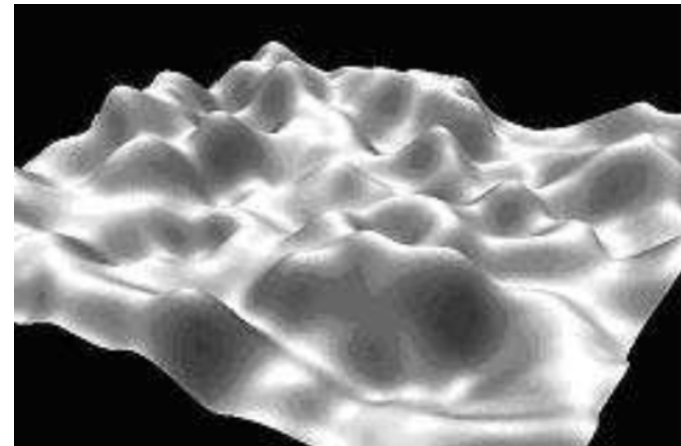
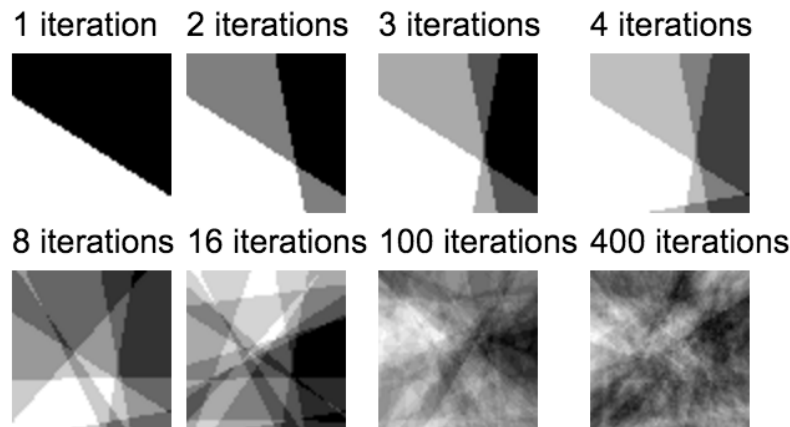
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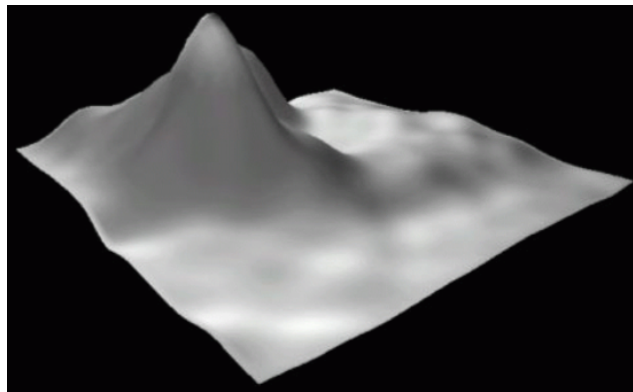


[Kamal, Uddin]

# Terrain generating algorithms

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- Midpoint displacement / Diamond-square algorithm
- Fault algorithm
- Repeated magnification and probing
  - Is able to produce a single mountain
  - Position, altitude and spread can be set by parameters



[Kamal, Uddin]

# Algorithms based on geology

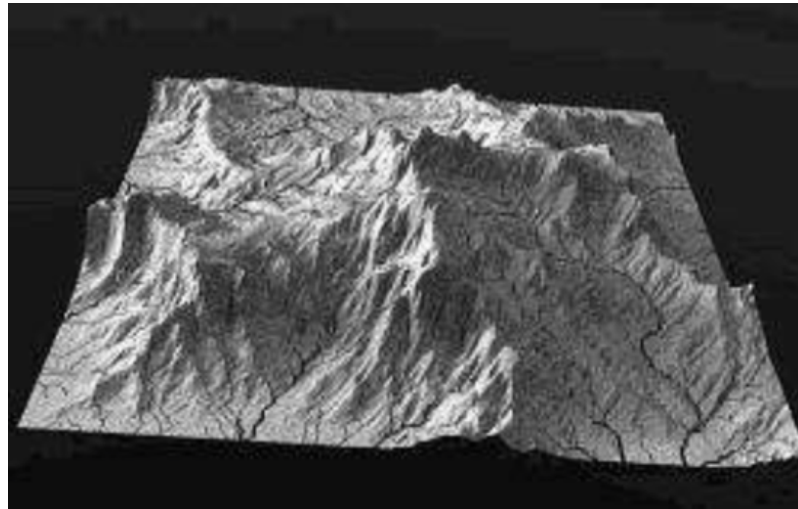
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- Erosion algorithm [Musgrave et al.]
- Algorithms considering tectonic plate movement

# Algorithms based on geology

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- Erosion algorithm
  - Simulates the influence of wind and water
  - Can only be applied to preexisting landscape
- Algorithms considering tectonic plate movement

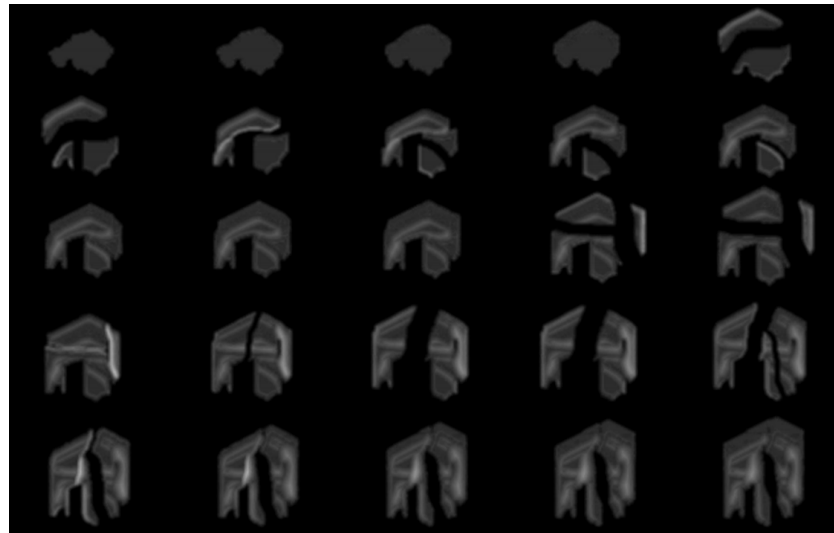


[Kamal, Uddin]

# Algorithms based on geology

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- Erosion algorithm
- Algorithms considering tectonic plate movement
  - Model how tectonic plates react when colliding with each other



[Lauri Viitanen]

# Planned schedule

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to do	until
Setup programming environment Create data structures Find a visualisation framework	end of december
Implement and test diamond-square as well as fault algorithm	end of january
Extend the RMP algorithm to support generation of whole mountain ranges	end of february
Implement erosion algorithms and combine them with already implemented terrain algorithms	end of march
Implement tectonic plate movement simulation	end of may
Write bachelor thesis	?



# References

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- K. Raiyan Kamal, Yusuf Sarwar Uddin, “Parametrically controlled terrain generation”, *GRAPHITE '07 Proceedings*, 17-23, 2007.
- Lauri Viitanen, “Physically Based Terrain Generation: Procedural Heightmap Generation Using Plate Tectonics”, 2012.