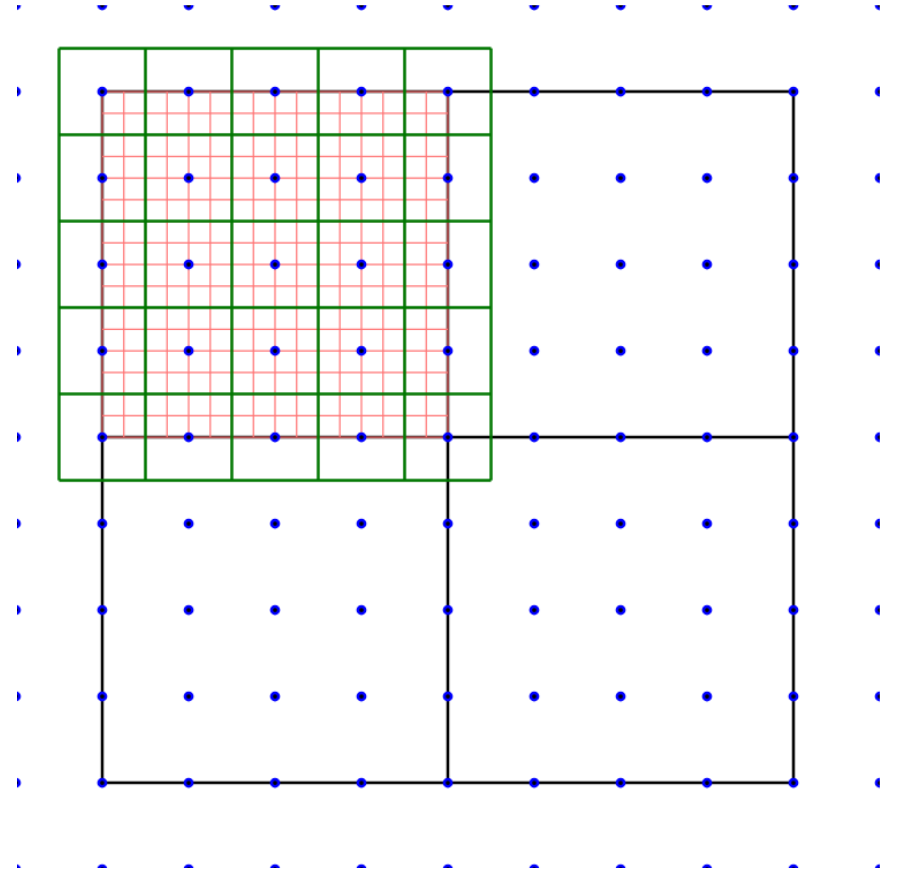# The Great UV Confusion

and why it is important to talk about it

Vertex grid, height maps and ortho photos

- Tiles
- Vertices
- Height map (5x5)
  - 1 texel overlap between tile borders
- Ortho photo (16x16)
  - Non-overlapping
  - Samples do not align with height grid

How to create an overlay texture
# *derived from a height map*?

Overlapping (like height map) vs non-overlapping (like ortho)?

Overlays with higher resolution than input heightmap?

Where to sample heights for to-be-calculated overlay texel?

Height-based overlay texture – No overlap?

- Non-overlapping, like ortho?
  - e.g. 4x4 (dots are height sample positions)

- Never aligns with height map
  - Always need to interpolate heights!
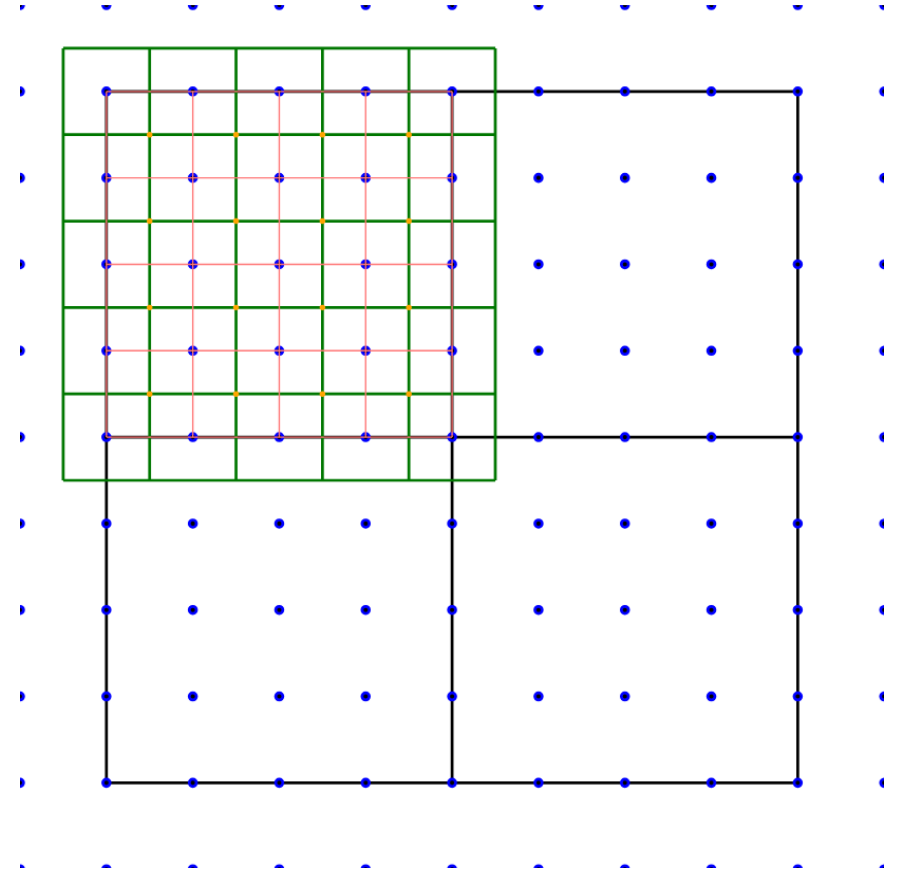
Height-based overlay texture – No overlap?

- Non-overlapping, like ortho?
  - Higher res, e.g. 16x16

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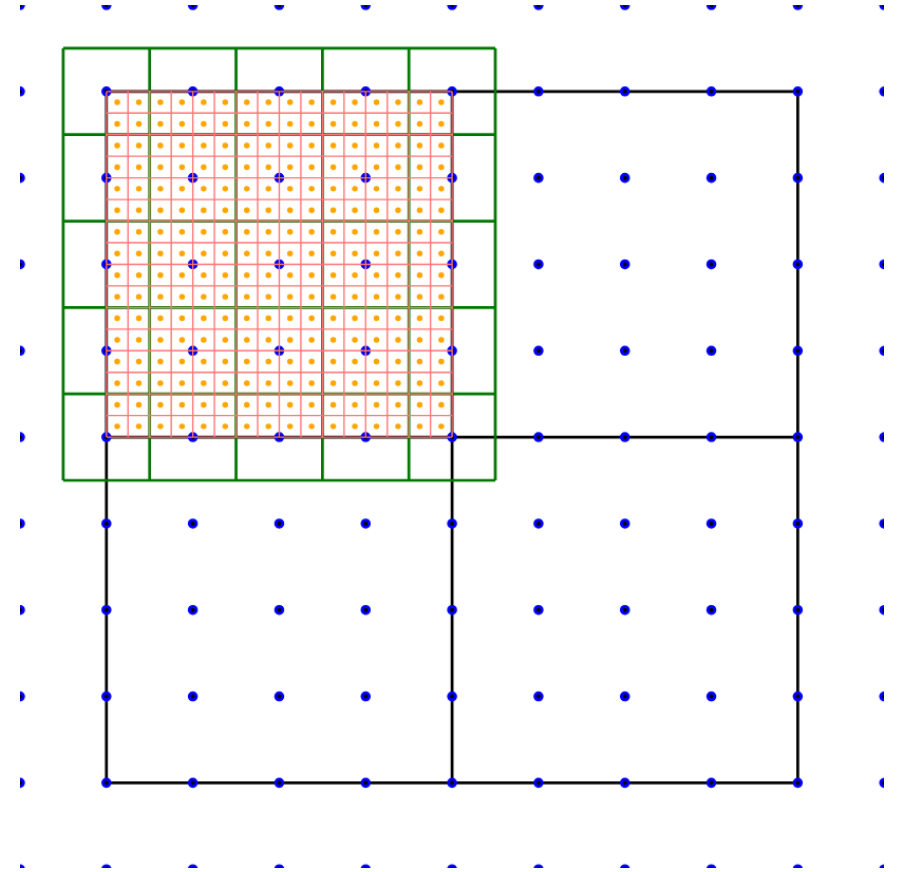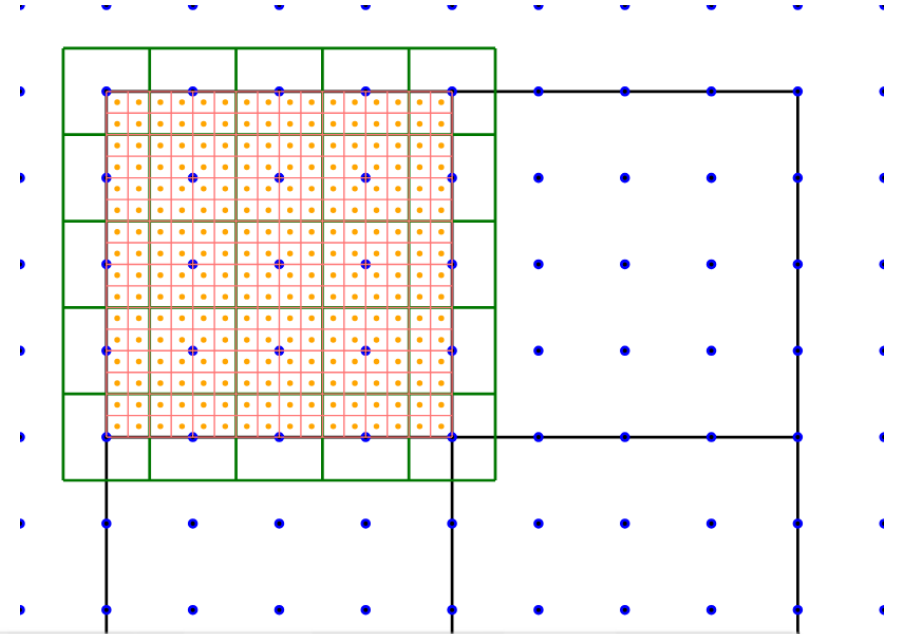
Height-based overlay texture – No overlap?
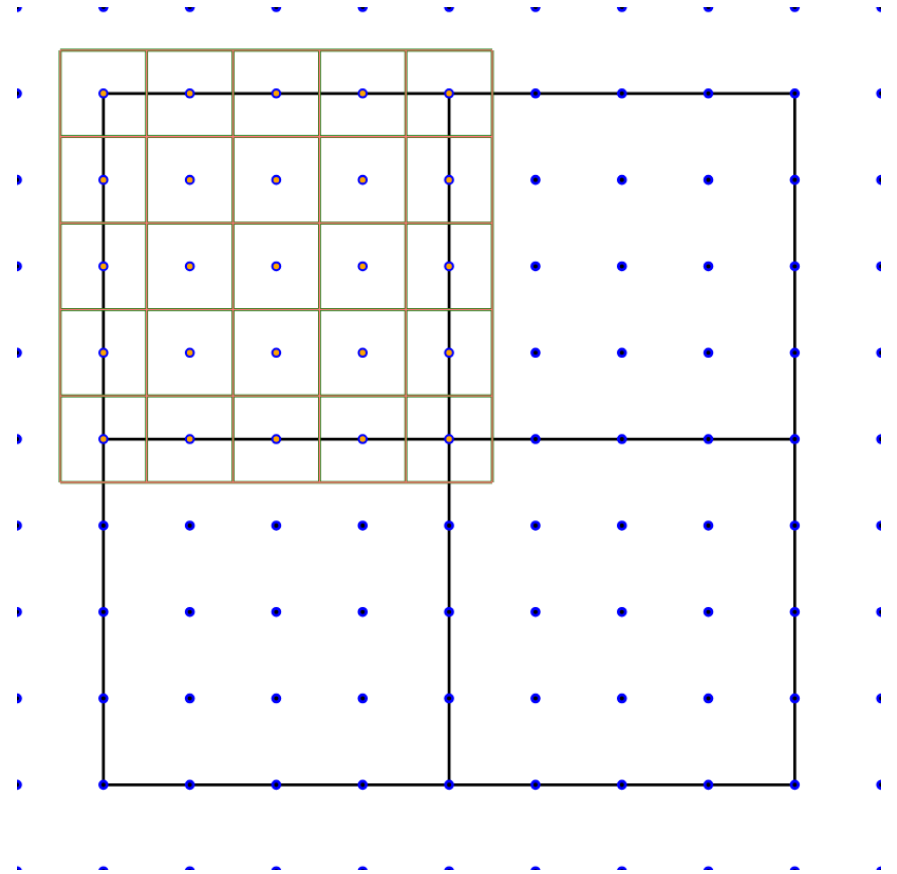
- Non-overlapping, like ortho?
  - Higher res, e.g. 16x16

- Never aligns with height map
  - Always need to interpolate heights!

- Height map UV from overlay texel pos:

$$\text{heights\_uv} = \begin{bmatrix} \frac{1}{2 \cdot \text{overlay\_width}} \\ \frac{1}{2 \cdot \text{overlay\_height}} \end{bmatrix} + \begin{bmatrix} \left(\frac{\text{col\_index}}{\text{overlay\_width}-1} + \frac{1}{2 \cdot \text{overlay\_width}} \right) \cdot \frac{\text{heights\_width}-1}{\text{heights\_width}} \\ \left(\frac{\text{row\_index}}{\text{overlay\_height}-1} + \frac{1}{2 \cdot \text{overlay\_height}} \right) \cdot \frac{\text{heights\_height}-1}{\text{heights\_height}} \end{bmatrix}$$
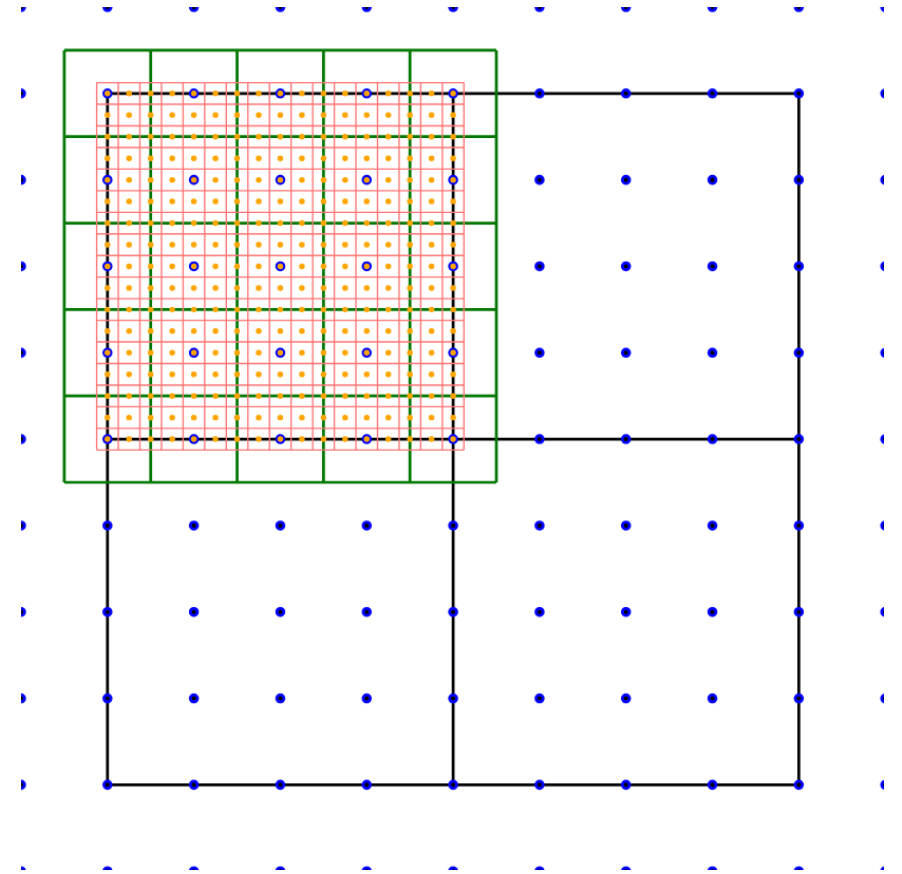
Height-based overlay texture – 1px overlap?

- 1-texel overlapping, like height map?
  - e.g. 5x5

- Aligns with overlay exactly (if same res)
  - Sample exactly at height map texel centers
  - Can use given height values
    no interpolation required

- Implications
  - need to offset vertex UVs when rendering
  - overlap region needs to be written to all per-tile overlay textures

Height-based overlay texture – 1px overlap?

- 1-texel overlapping, like height map?
  - o Higher res, e.g. 17x17

- Some samples between height texels
 - o Need to interpolate heights at that points

Height-based overlay texture – 1px overlap?

- 1-texel overlapping, like height map?
  - Higher res, e.g. 17x17

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- Height map UV for overlay texel pos:

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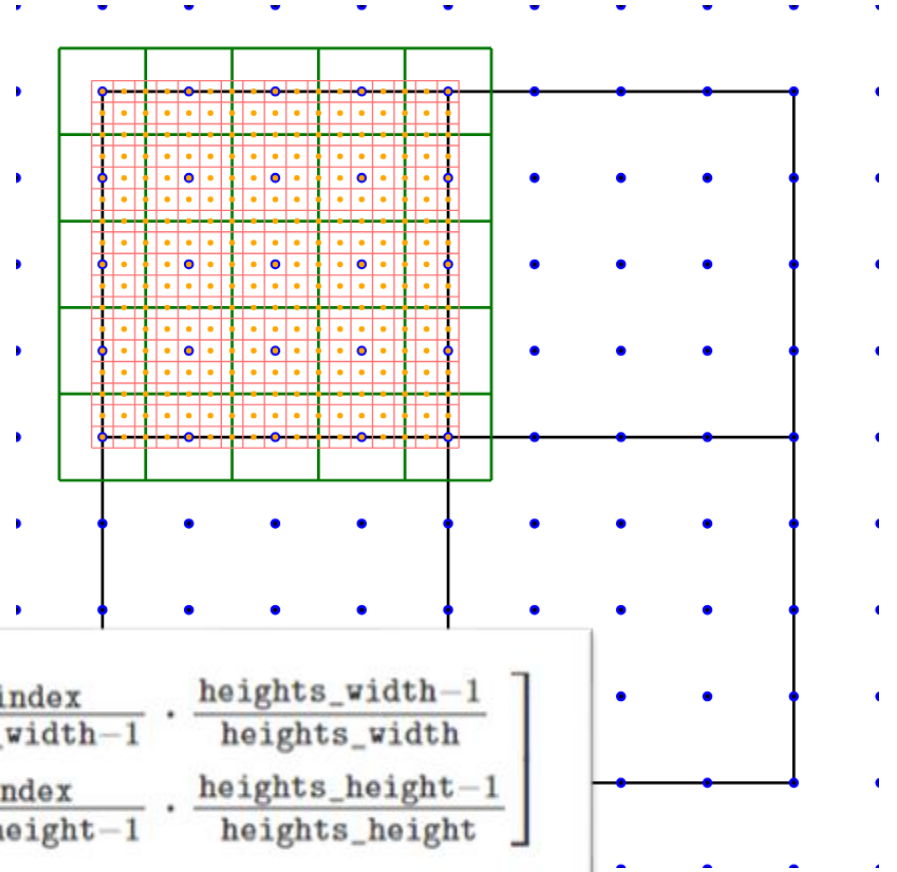
Considerations I

- Remark: our continuous approaches always needs interpolation
  - => mainly important for grid-based approaches directly using DEM

- Comparison with state-of-the-art
  - Flow-Py and Flow-R work directly on the height grid
    => their output raster aligns with the height raster
    => to compare, our output needs to align with theirs

- Is interpolating heights (for simulation) alright?
  - Values between height samples are not really known
  - Interpolation is only an approximation, can be wrong

Considerations II

- Image quality
  - Possible to draw finer trajectories on finer grid
  - If higher resolution than height maps
    => need to sample/interpolate heights

- Performance
  - Overlapping texels need to be written to multiple texture/buffer positions
  - Probably neglectable for now