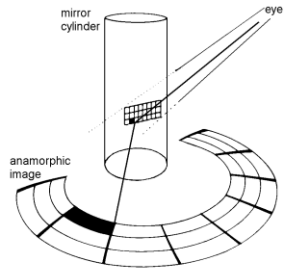
Pattern Matching in Mirror Anamorphosis

by Dirk Remmelzwaal

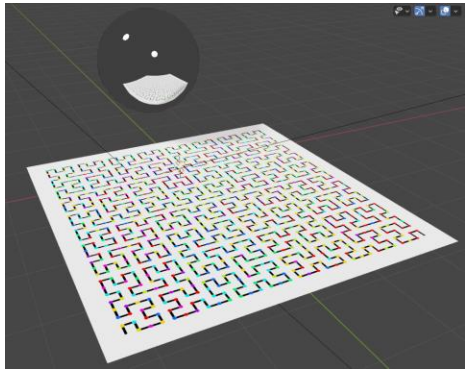
Problem Definition

- Finding a mapping from a source to its reflected image
- Labour-intense when lacking information on mirror topology
- Existing pattern matching solutions are not robust in this context



Christian Ucke, Technical University Munich

Scene Layout

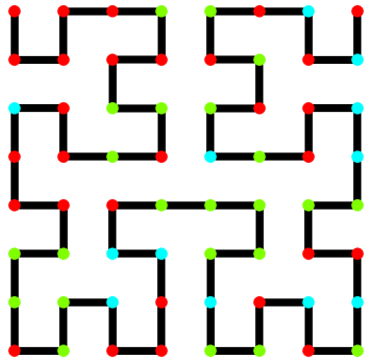


Blender scene used: a reflective sphere and a textured plane. A rod is added on second iteration. The pattern parameters are n=8, k=5

Solution

1 Dimensionality reduction

- Dimensionality reduction from 2D to 1D using Hilbert curve
- Variable pattern density on a local and global scale



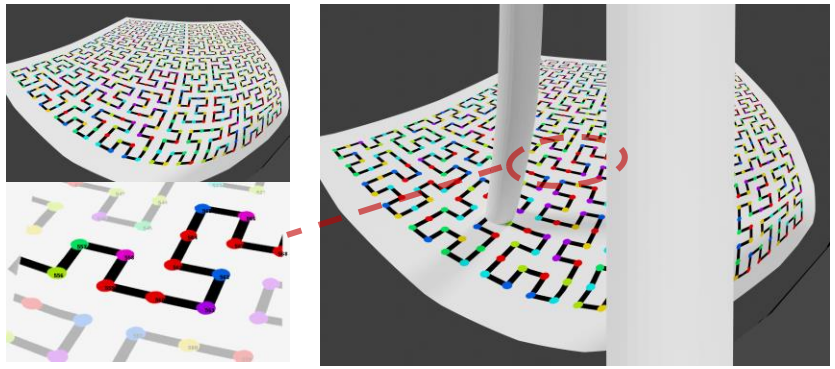
Instance of pattern with n=3 colours. Each substring of length k=5 or greater is globally unique

2 Global uniqueness

- Markers along the Hilbert curve
- Use of a finite set of n colours
- Any substring of a minimum length k should be unique
- Cannot determine traversal order: must be mirror-resilient

Results

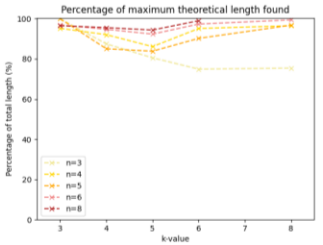
- Ability to match nearly all markers to their correct location
- Even with major obstruction, still able to identify majority of points

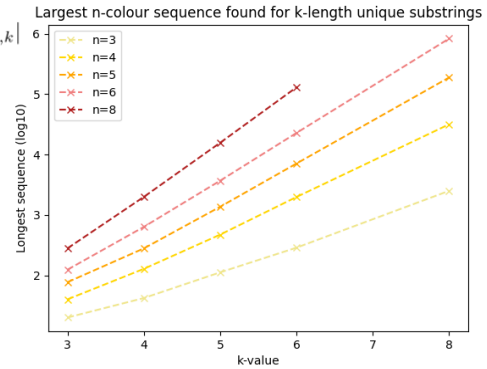


- Sequences generated using depth-first search
- Upper bound mathematically defined for sequence length $|U_{k,n}|$
- For high values of k, closely approximates upper bound

$$|U_{k,n}| \leq k - 1 + \frac{n^k - |P_{n,k}|}{2} + |P_{n,k}|$$

with $|P_{n,k}| = n^{\lceil \frac{k}{2} \rceil}$





Conclusion

- Pattern matching can succesfully be applied in mirror anamorphosis
- Using only local adjacency, a globally unique region can be identified
- Sequences can be defined which are unique on given substring lengths
- Sequence lengths approach their upper bounds for larger minimum unique substrings

Future Work

- Inferring unconnected colour markers
- Varying Hilbert curve depth for different regions
- Establishing a robust colour set
- Use marker shape for additional mapping info
- Add regionally exclusive sequences to pattern
- "Banned" sequences to detect false positives

supervisor: Baran Usta
Responsible professor: Elmar Eisemann

TU Delft

CSE-3000 (Research Project)