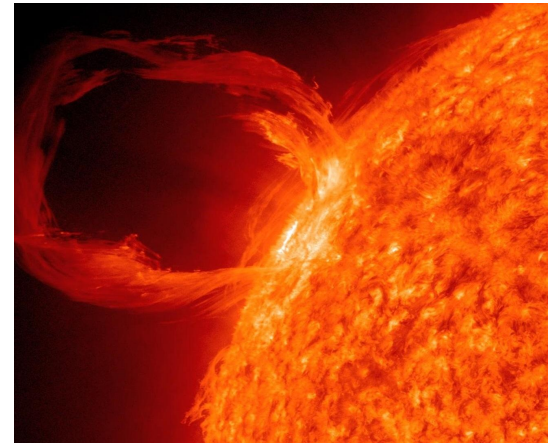


# Sculpting Procedural Noise

M1 MoSIG Research project - 2022

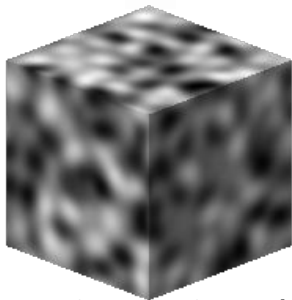
Mathéo MOINET  
Advisor : Fabrice NEYRET

# What we want to achieve



# Why it is hard

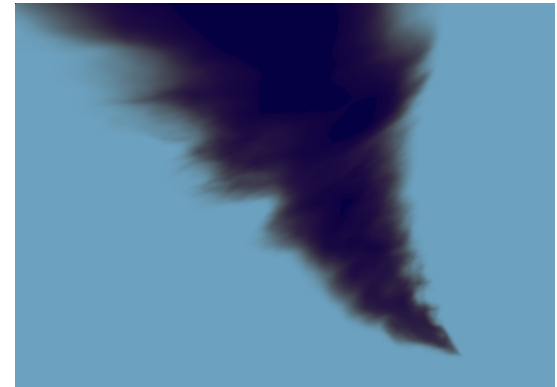
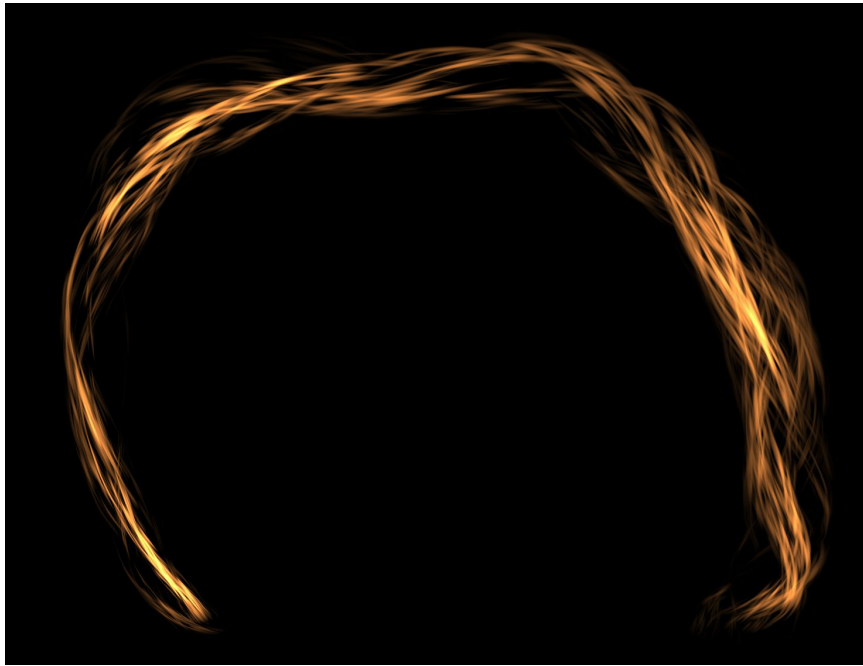
Stochastic volumes → Density fields



1. Much more intensive than normal rendering.
2. Procedural generation is also expensive.
3. Compatible with modeling and design.
4. No existing workflow to create anisotropic density fields.



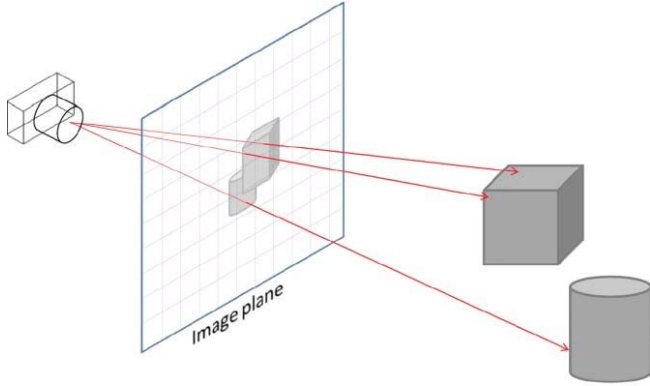
# Results overview



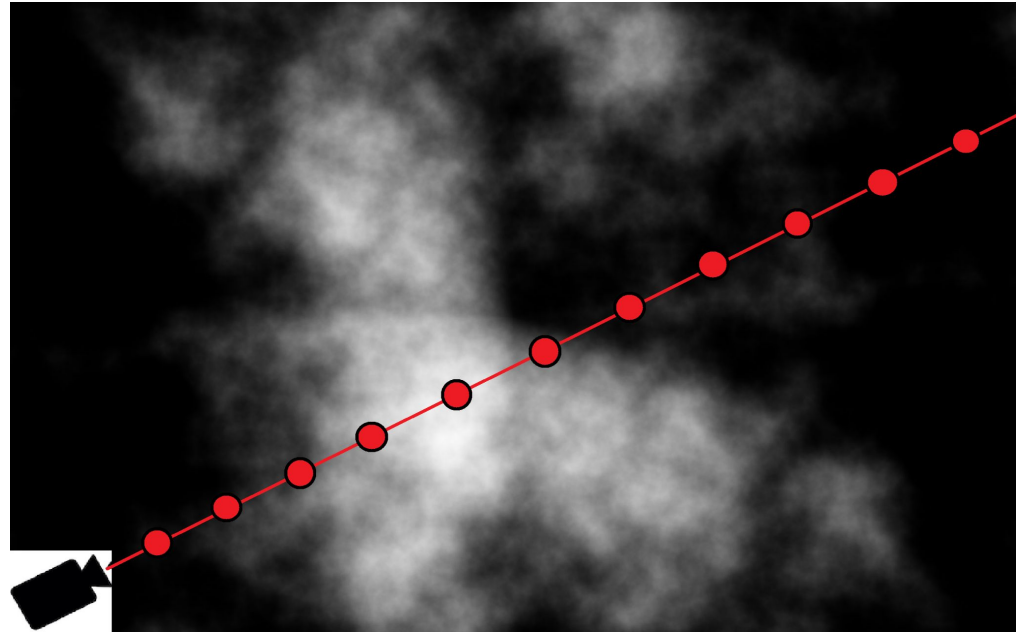
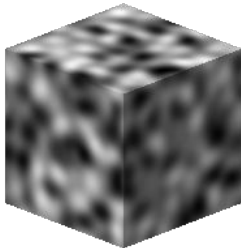


# Previous work: rendering

Surfaces: simple



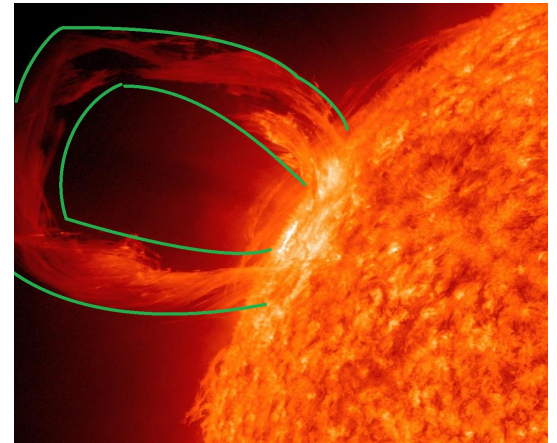
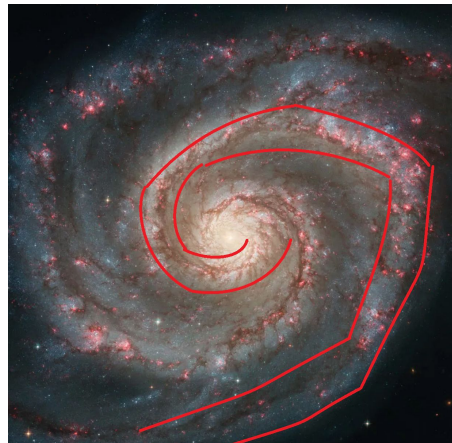
Semi-transparent density field ?



# Our main hypothesis

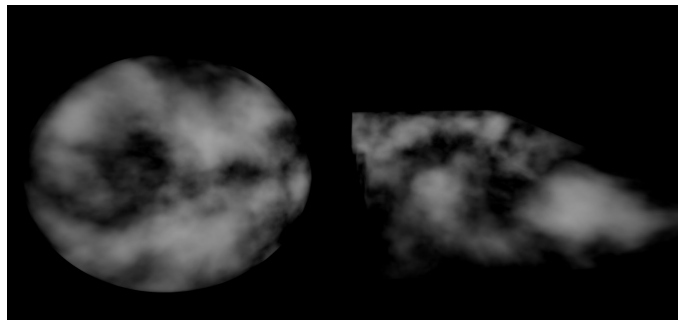
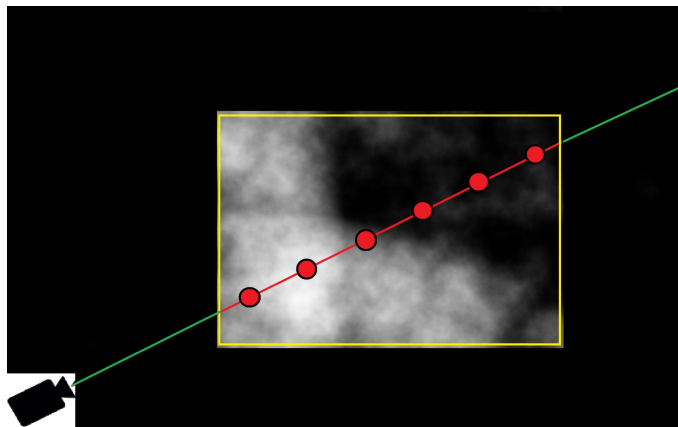
Our target objects have properties :

1. Mostly void
2. Tube shape
3. Deformations created anisotropy

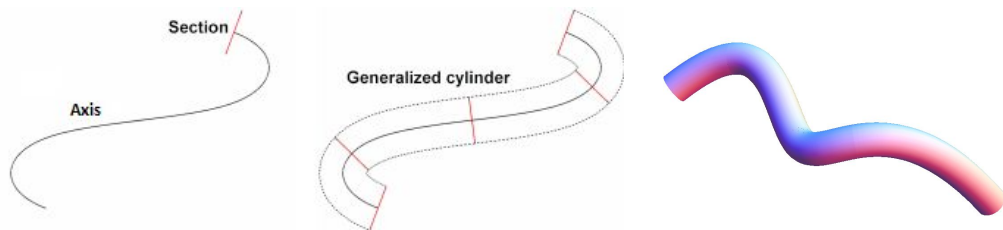


# Our renderer

Bounding Shapes:

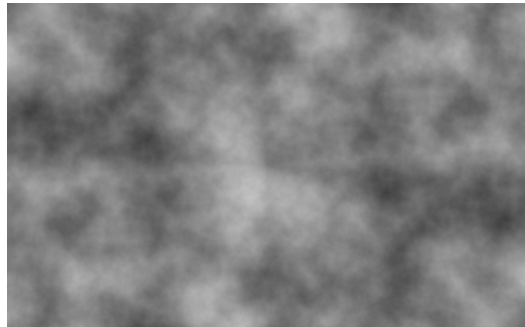


Spline tubes - Generalized cylinders:



# Previous work: noise

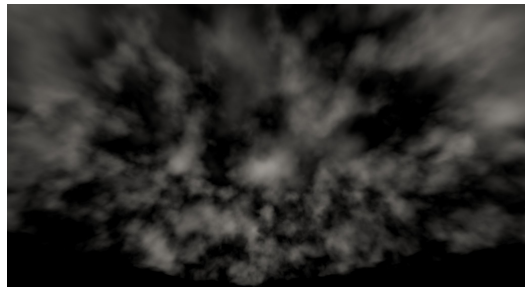
Perlin noise sum



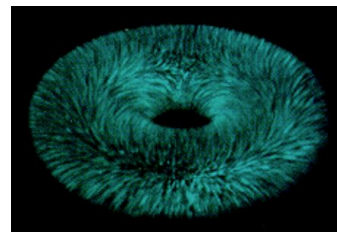
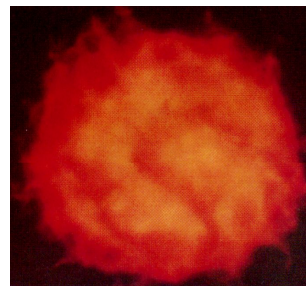
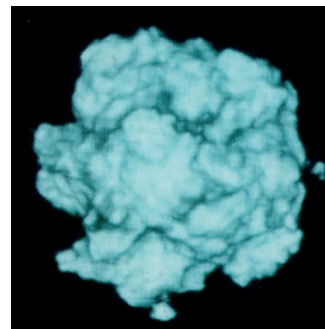
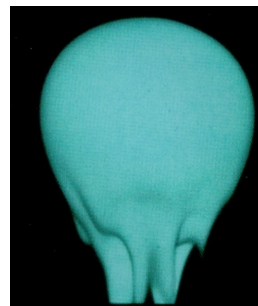
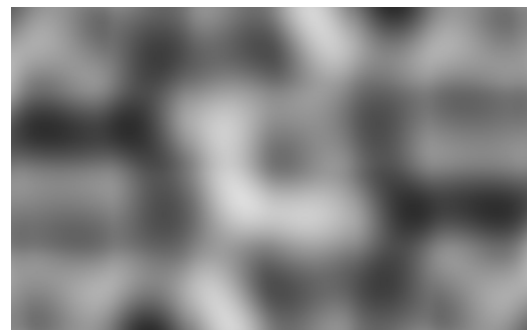
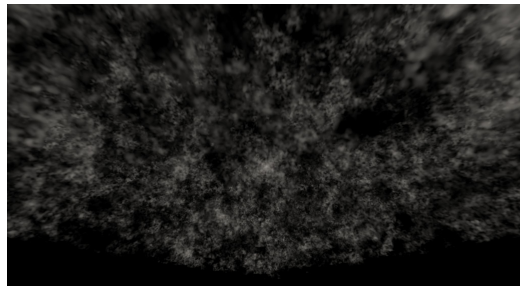
Perlin noise mult



3D clouds

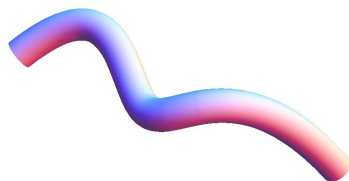
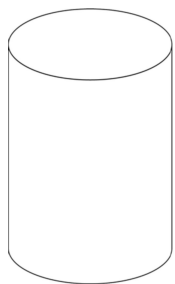


3D dust

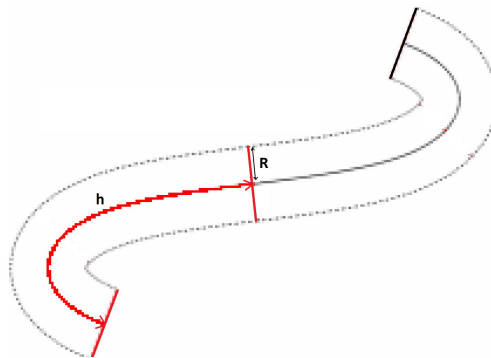
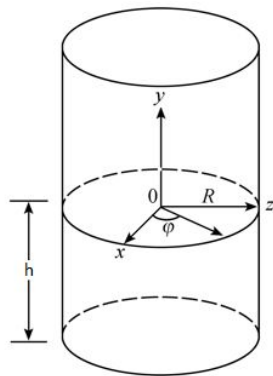




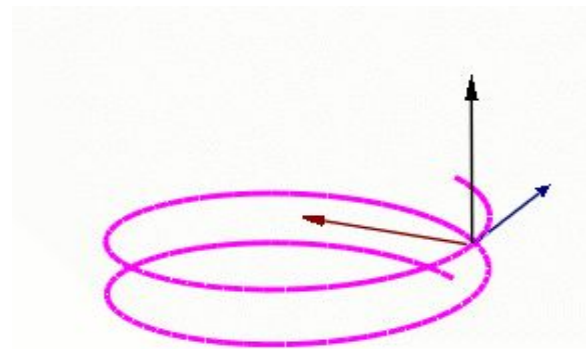
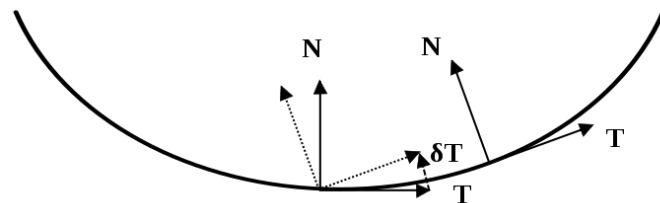
# Deformation from a reference frame by spline tube mapping



Cylindrical coordinates:

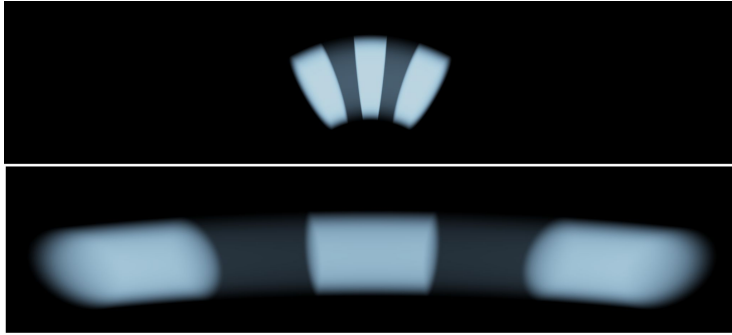


Frenet frame:



# What kind of deformations

Stretching:



Varying radius:



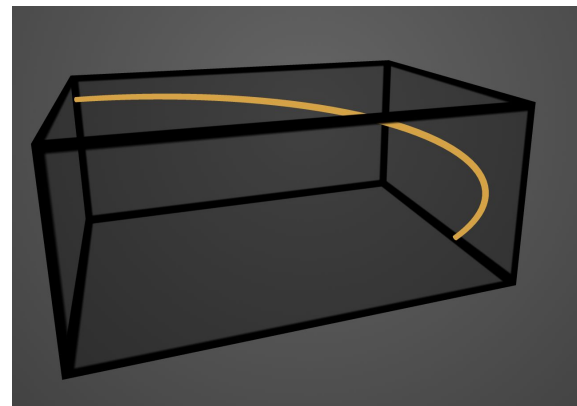
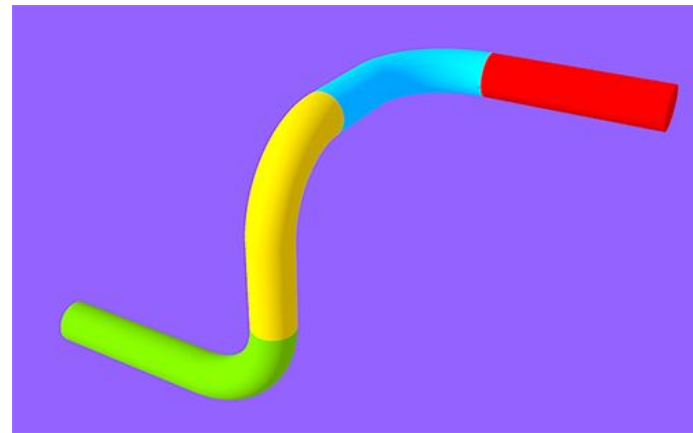
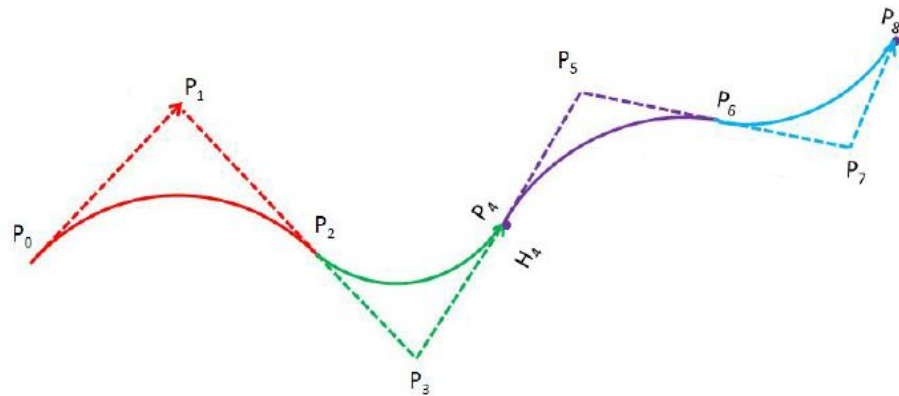
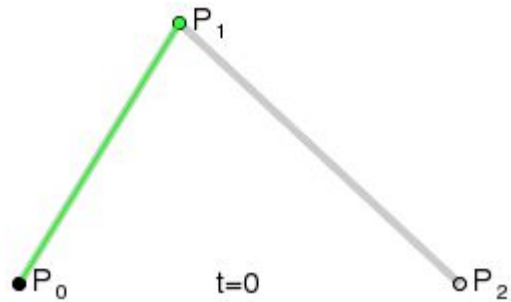
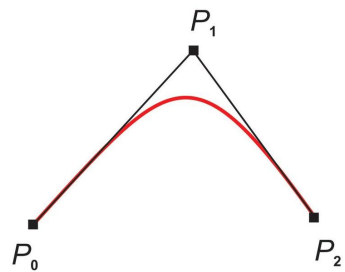
Twist (rotation around axis):



Density stretching (conservation of mass):

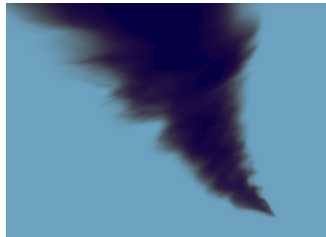


# Quadratic Bezier tubes



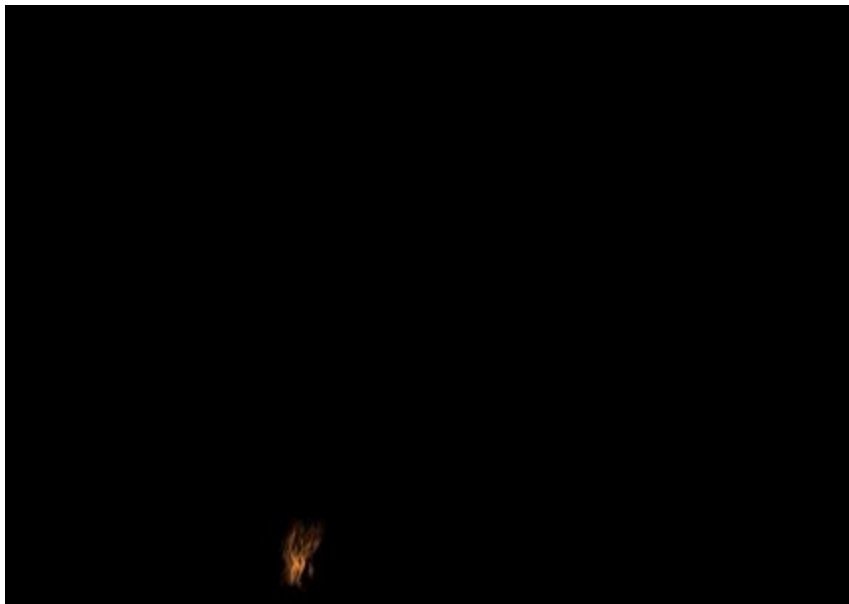
# Performances

Performance Metrics - RTX 3070 (laptop) - 960x540			
Times (fps)	Tornado	Solar Flare	Galaxy
Normal	140-190	60-65	25-27
Simpler noise	220-230	120-125	85-90
No noise	230-240	140-150	130-135
Double step size	215-230	105-110	45-50
Quadruple step size	250-260	160-165	88-90





# Results



# Conclusion & Future work

- Innovative approach to generate anisotropically deformed density fields
- Combination of multiple rendering techniques to make real-time possible

## Future work :

- Use splines instead of Bezier curves
- Ray-casting instead of Sphere marching
- Interpolated mapping
- Renderer extensions (e.g. shadows)

# Thank you for your attention



## Questions ?