

# Hybrid Pseudo Kleinians

a pragmatic approach of a 3d fractal hybrid, which combines the formal properties of two fractals in one system.

Pseudo Kleinians are a type of fractal, graphically similar to Kleinian fractals, but of a completely different formal math origin. The principle was discovered by a user called Theli-at back in 2011

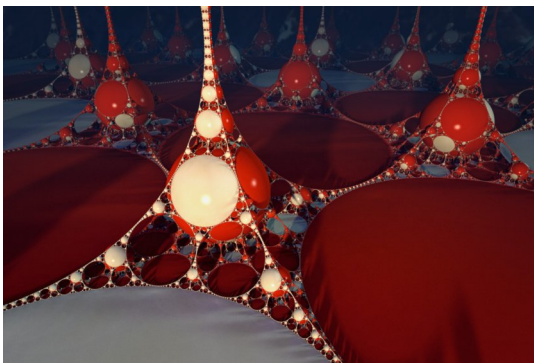
<https://www.deviantart.com/theli-at/art/Kleinian-drops-192676501>

Soon after this post a coder called knighty - well known in the genre of fractals - optimized the principle in a custom Pseudo Kleinian DE (DE = distance estimate, a raymarching technique), a standalone formula. A great achievement, that I used myself in several artistic pieces.

The difference is, that the standalone version adds spheres to fill the space. In the hybrid display you can fill the space with a second fractal like shown in this gallery.

Besides working out the details, my achievement was to show, that AmazingSurface can be configured, that it “generates” a PseudoKleinian grid, just like AmazingBox.

And in fact building a PseudoKleinian only from AmazingSurface, was the starting point for my exploration of that system.

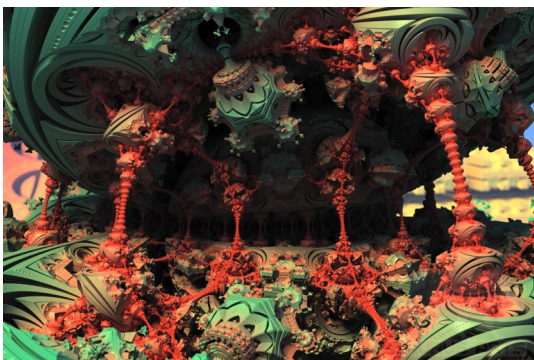


The essence, I saw in Theli-at's combo is (simplified)

$\text{transform}(\text{boxfold} \mid \text{ballfold}) + \text{transform}(f2) + c$

All following examples work with that pattern.

*Pure shape in Julia mode*



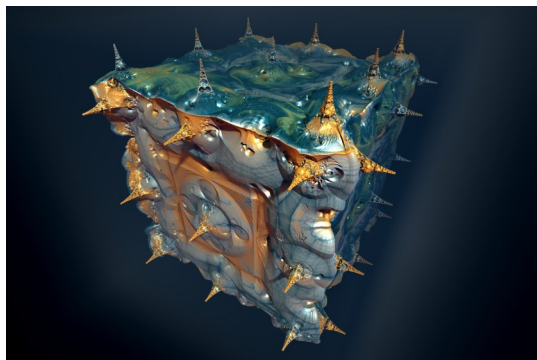
The shown principles are implemented in Mandelbulber, one of the common programmes for that task. In Mandelbulb3d – the other common software – this can only partly be reproduced with restrictions in choice of formula 2.

*A Mandelbulb3d portation with Abox in slot one and two.*



Initially my aim was to implement “box-like” fractals – AmazingBox (Mandelbox), AmazingSurface and others. This worked pretty well and it soon turned out, that formal properties of fractal 2 can be projected almost undisturbed in the “Pseudo Kleinian grid”. And even more. All standard formulas work in the given pattern with full preservation of formal properties in formula 2.

*Asurf with Abox in slot two*



The main difference between hybrid Pseudos and the dedicated Pseudo Kleinians is, that the addition of  $c$  – the global constant – remains a leading parameter in the hybrid construction. This constant “clamps” the iteration cycle in some way.

*Mset of Asurf with Abox in slot two*



Clamping means, that the global constant  $c$  is not added after Asurf, as it is essential in single formula use. It is added after the last transformation (slot 2, 3 or whatever is the last) in iteration cycle.

Indeed this was the initial idea, before I started to work this out.

*Asurf with Abox in slot two*



Asurf Pseudo provides the possibility to project shapes of another formula into a “pseudo Kleinian net”.

That this works for BoxFold-BallFold fractals (as the Mandelbox and Asurf) was no surprise, as they add a constant  $c$  in single formula use as well.

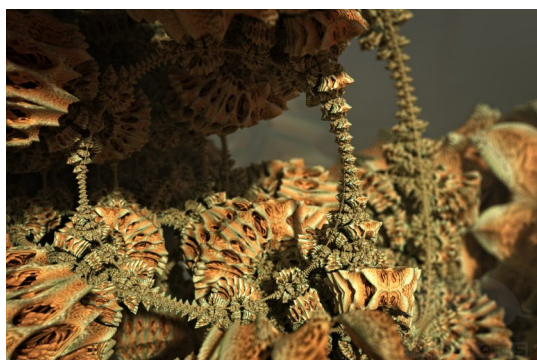
*Asurf-Abox hybrid with some rotation*



The second guess was the Mandelbulb, as the addition of  $c$  is standard behaviour in single formula use as well. But most bulbs didn’t work well in Asurf Pseudo. They tend to fall apart under iteration.

This bulb (Benesi - Pwr2 Mandelbulb to be precise) doesn’t.

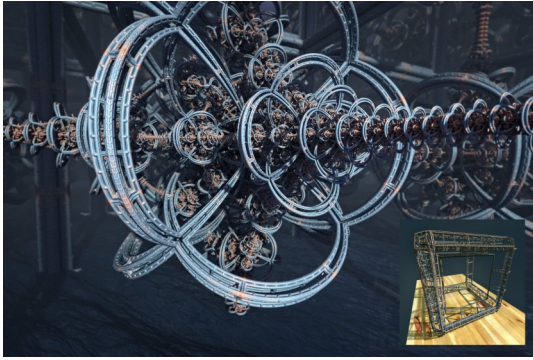
*Asurf - BenesiBulb*



This is another Bulb in slot two – Mandelbulb quat – that shows very nice results.

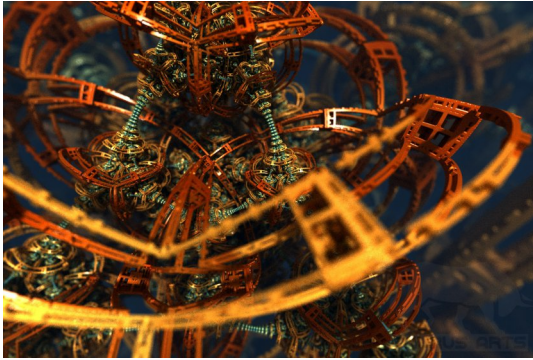
*Asurf - Mandelbulb quat*





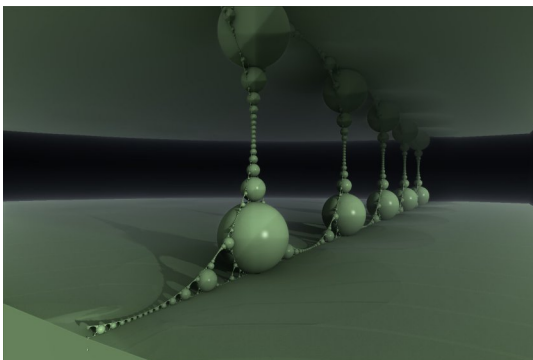
In the end it turned out, that it makes no difference, whether a formula generically uses a constant or not. Virtually all standard fractals can be applied to Asurf Pseudo concept – with full preservation of the formal properties of the used fractal. Here with a kaleidoscopic IFS you see bottom right in single formula use.

*Asurf - KIFS*



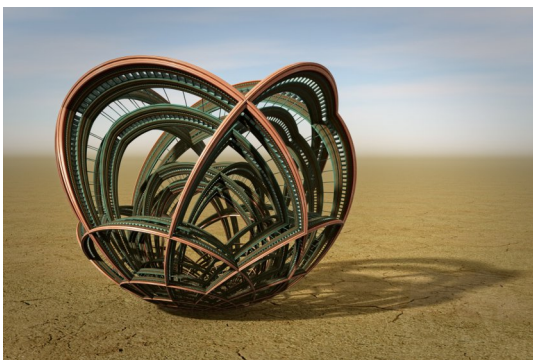
A classic fractal – a Menger Sponge – in slot two. This shows nicely, how the formal properties of fractal two shows up in the Pseudo Kleinian order. The global constant  $c$  in Asurf Pseudo gives the opportunity to control the density and shape of that appearance.

*Asurf - Menger Sponge*



A specialty of AmazingSurface. Without rotation a Pseudo Kleinian in extended 2d can be created. I once called this a 2.5d Pseudo Kleinian. A rather metaphoric description. This is different to all other Pseudo Kleinians, also the dedicated Formulas.

*Asurf - Asurf*



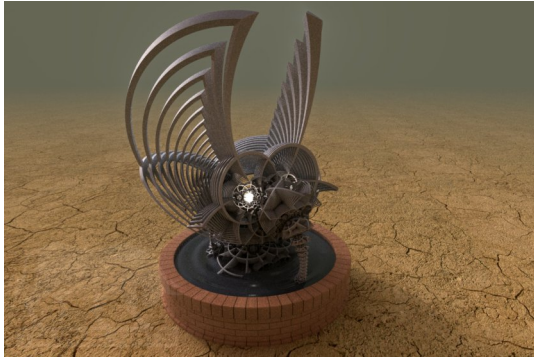
This is an elaboration of that 2.5d Pseudo. The figure is cut out by a surrounding sphere.

*Asurf - Menger sponge*



A sphere inversion as pre transform helps to grasp the object, creating a limited entity. At this point I first had the impression, that a circle closes – or a sphere...

*3-slot combo with Sph\_invert, Asurf and Abox*



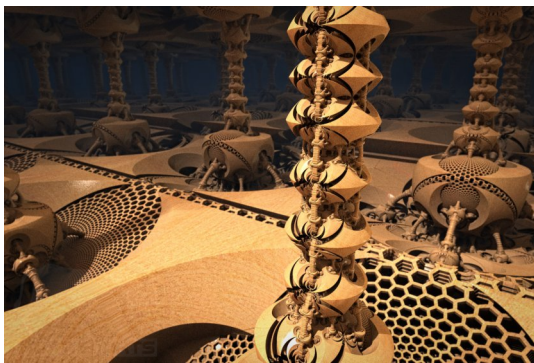
Finally there is a (simple) way to integrate basic transforms like rectangular grids, tri- and hexgrids and some more complex, dedicated transformations into the Asurf Pseudo concept.

*Sph\_Invert - Asurf - tdifs\_gridV2*



Even more than one of those transforms – I tried up to three – can be applied to Asurf Pseudo at the same time. And all show up in final shape.

*Sph\_Invert - Asurf - tdifs\_prism - tdifs\_hexgrid*



Just for comparison here a dedicated Pseudo Kleinian with the same transformations attached as in previous image – except the sphere inversion. The same buttons (values) to tweak, but a pretty different outcome. Intendently a bit overstated for clarity.

*Asurf - tdifs\_prism - tdifs\_hexgrid*

I hope, I have been able to provide some insights into the process of implementing this fractal system. The approach is mainly based on geometric observations and not on theoretical considerations. So the analytic, algebraic part will not be discussed here.

Originally, mathematics tried to describe regularities in the observed world. Here I tried to describe geometric principles, in experimental observation. The value of that approach might be judged by others.

have fun!  
Torsten