Towards flying through modular forms

David Lowry-Duda and Adam Sakareassen
Bridges 2021

ICERM and Brown University
I research number theory. Frequently, I use “highly symmetric functions” called modular forms, whose definition is unilluminating:

A modular form $f$ is a complex-valued function from the half-plane to $\mathbb{C}$ that satisfies an infinite number of functional equations of the shape

$$f\left(\frac{az + b}{cz + d}\right) = (cz + d)^k f(z)$$

for various quadruples $\left(\begin{array}{cc} a & b \\ c & d \end{array}\right)$ and some fixed integer $k$. 
I’ve written several papers exploiting modular forms, or describing how to compute them, or how to make sense of their properties. Recently (inspired in large part by the 2019 ICERM program *Visualizing Mathematics*), I began to study what modular forms look like?
With Adam Sakareassen (who has taught me everything I know about quality 3d rendering), we began to explore modular forms in 3d.
We’ve begun to make not just 3d images, but movies and gifs.

Our first is at https://www.youtube.com/watch?v=s6sdEbGNdic
We’re taking this in different directions. As before, we began with the informational and we’re moving towards both educational and beautiful.
And also, a bit of the ridiculous. (This is my wife and I visiting Iceland, standard on the left and *symmetrized* and used as a modular form wallpaper on the right).
Thank you very much!

More visualizations and details about modular forms appear on

davidlowryduda.com
visual.davidlowryduda.com