Numerical Methods of Raytracing in Curved Spacetimes According to Einstein's Theory of General Relativity

Szewczyk, Jakub

Uriasz, Grzegorz

Our project is a computer program generating images and data based on a description of a scene – its objects (planes, spheres, triangles) and geometry – the curved spacetime. We have used Einstein's Theory of General Relativity equations in order to find the paths on which light traverses, and based on this implemented an algorithm that allows us to use these paths for image generation. It also uses Runge-Kutta methods of numerical integration in order to significantly decrease the computational error. Our program can simulate both the light bending effects of gravity and gravitational Doppler's effect – so-called redshift. We have analyzed the accuracy and precision of our calculations by comparing the values obtained from our models to ones obtained from purely theoretical model of Schwarzschild's metric. The tool we have created can help to create a better understanding of physics in a curved spacetime by creating images that can improve our intuition, but also be used to conduct further scientific research in the area of relativity. Specifically our work can be used to support astronomy and theoretical physics by providing accurate and fast simulations of curved spacetimes.

Awards Won:

Fourth Award of $500