

# Visualization & CAD

*Animation of the procession of penitents among penitents*



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Patrik Chukir xchuki00@stud.fit.vutbr.cz

Faculty of Information Technology

Brno University of Technology

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# Introduction

As part of this project, a scene will be created in Blender containing a model of snow penitents and an animated passage of human penitents with candles. The project will use modeling tools, tools for creating materials and textures using nodes and tools for skeletal animation. All project files are available at <https://github.com/xchuki00/VIZa>.

## Theoretical foundations

### Subdivision modeling

Subdivision modeling[1] is a technique or method of creating models from basic shapes, cubes or surfaces, gradual division of the surface into smaller and smaller primitives. The division can take place either flatly, the whole object, or only locally. In Blender, tools such as *knife*, *loop cut* or *subdivide* are used to do this (quarter each square of the object's surface). This procedure allows you to first model the rough features and gradually refine. The result of this modeling can be converted to a T-spline model.

### T-splines

T-splines is a surface description method similar to description using NURBS curves, it just doesn't need a regular square network of vertices. The method uses a network of points and a T-spline curve to describe the surface, the principle is quite similar to the classical surface description only instead of connecting the surface with flat surfaces, the points are connected by curved planes according to the T-spline curve. This representation allows you to create smoother and rounder surfaces with minimal increase in model size. This makes it possible to create round and organic shapes without a high number of points. We can create these models on the basis of a model created, for example, by Subdivision modeling, or by defining a cross and dragging / rotating it ..., and then joining the resulting shapes.

### Textures

The texture generally defines the optical properties of the model. It can be just an image mapped to a model, or a whole set of "images", defining optical properties such as roughness, normal, reflectivity or even color. Thanks to them, the model acquires a realistic appearance, so that instead of constant color and optical properties throughout the object, different places may have a different reflectivity or color. In the blender, the textures are wrapped in the material we assign to the object or its parts. This material is a collection of several types of textures, contains color, roughness, luminosity and so on. Using the Node editor / Shader editor, it is possible to connect an input node to each property, instead of a fixed value (Roughnest = 0.5), either an image, a noise generator or voronoids

and more. For each object that is supposed to have a texture I need a generated UV map, a coordinate system telling where the vertex lies on the texture. The UV map therefore maps the points of a 3D (mostly) solid to the points of a 2D (mostly) texture. Textures do not necessarily have to be 2D, they can only be 1D, ie the body points are then mapped to a straight line, or even N-D, then it is a set of 2D textures.

## Motivation and goals

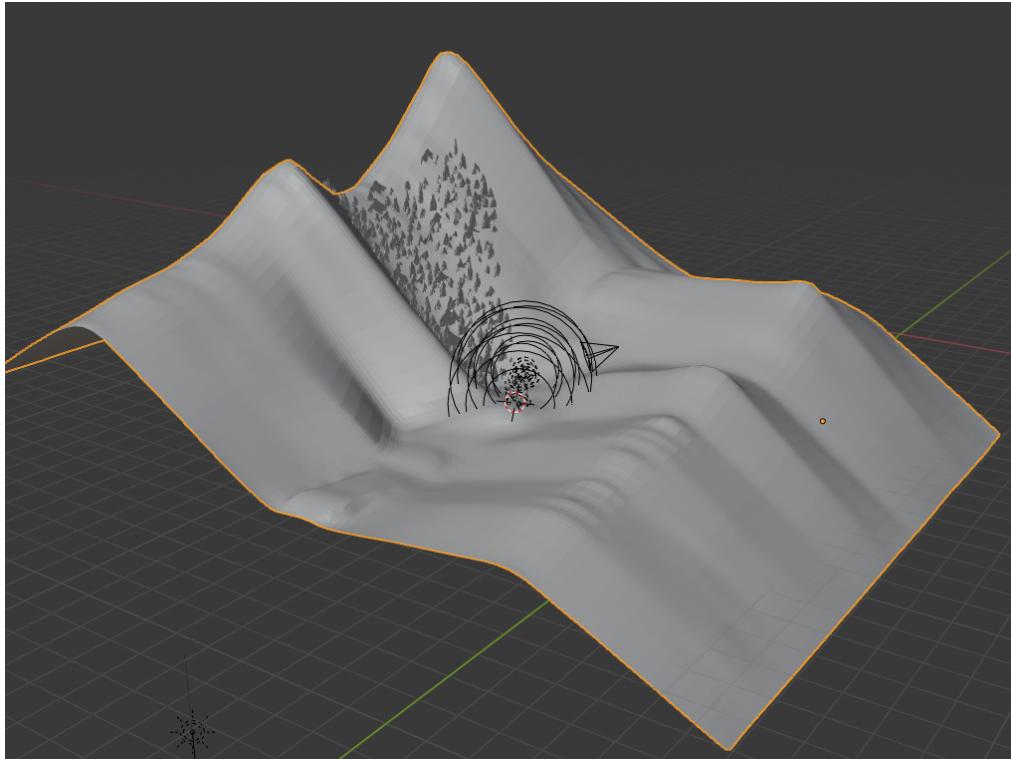
The motivation was to create a more complex model for the diploma thesis, the assignment of thesis is Simulation and Visualization of Snow, specifically deals with the volumetric rendering of snow formations of Penitents. And in order not to sell the same work twice, I decided to expand the scene with a procession of penitents, that is, a procession of people repenting in a special kind of cloak after which the snow formations are named. Furthermore, my motivation was to try as much functionality as possible in Blender.

## Workflow description

I divided the project into several tasks: creating the terrain (hillside and path), installing models of penitents (snow formations) on the mountainside, creating a model of a human penitent and then animating the scene.

### Terrain

I modeled the terrain from the surface, at first I only slightly divided this surface and wrinkled it by moving vectors with *Proportional editing object* turned on, then on *sculpt mode* crept up and lifted the road embankment. In the case of this model, I spent much more time than modeling trying to create a believable texture. I originally tried to combine two nodes *Principel BSDF* in the *Shader editor*, each set the base and background colors, then used the noise to determine the ratio of translucency of the background color and mixing between the two nodes, but the result was not very good, he resorted to texture based on a photo downloaded from pixbay and used that photo as color input for one of the *Principel BSDF* node. I also adjusted the normals and roughness of the textures based on one noise function.



## Snow formation Penitents

These are about twenty different models created within my diploma thesis, for the purposes of this project I placed them on the hillside, due to the high variability and randomness of the terrain, it was necessary to place each department by hand. I duplicated the original twenty models and created a smaller penitent field of about 160 formations. They are also supplemented by a material with a basic white color, a little light blue light and a voron diagram determined by the light blue translucency.

## Model of Penitent(human)

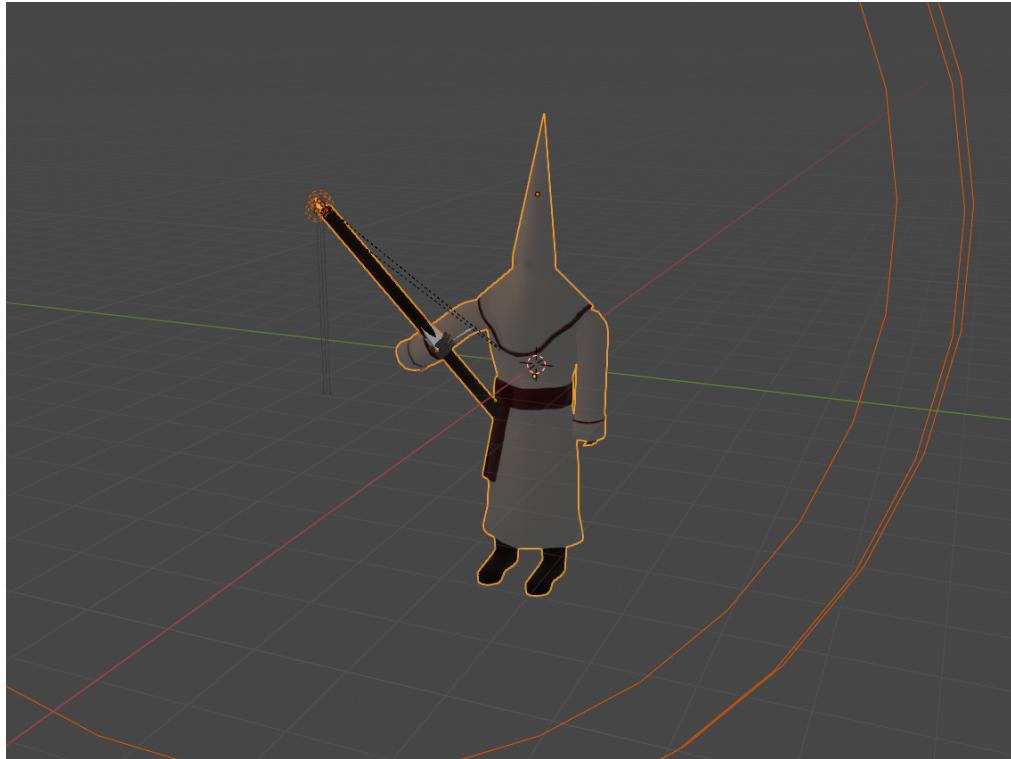
To inspire the shape and appearance of the characters and therefore their clothing, I used a photo from pinterest<sup>1</sup>. This is due to the specificity of the robe he wears. As mentioned above, this garment is inspired by the penitents I modeled.

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<sup>1</sup><https://www.pinterest.es/pin/419116309057507217/>



Otherwise, this whole model is created in Blender, using subdivision modeling from cylinders (body, candle), palms and legs are formed separately. Subsequently, the model was completed with a skeleton with automatic weight distribution, which had to be adjusted in the area of the feet. Because both feet were affected by the bones of one foot, ie. that while moving my left ankle, my right and left foot moved asymmetrically at the same time. Plus, of course, the texture had to be completed. In this case, the whole hand-painted, it is a white surface with burgundy edging, sash and a few details. Unfortunately, the candle does not have a thoroughly modeled flame, only static, but unfortunately it is not very visible due to the size of the scene. So I realized that there is no need to model the flame more thoroughly than just for the outline itself, its existence. The flame has a material with a set emission in orange, and then three point light sources of different shades of yellow to orange and with different intensity and range (the darker the light the smaller the range) are connected to it to create the illusion of a true flame.



## Animating

The animation is created using the Penitent of the Penitent, the biggest problem was the length of the character's step. Because when walking downhill, uphill or on a straight line, its length and inclination change. For this reason, each step had to be modeled separately. To make it easier, I created a third texture for the terrain. I marked my footprints on it to know where each foot should step on and where each foot bounces off. All five penitents who appear in the resulting animation are therefore copies of the first, only with a shifted timing.

## Results

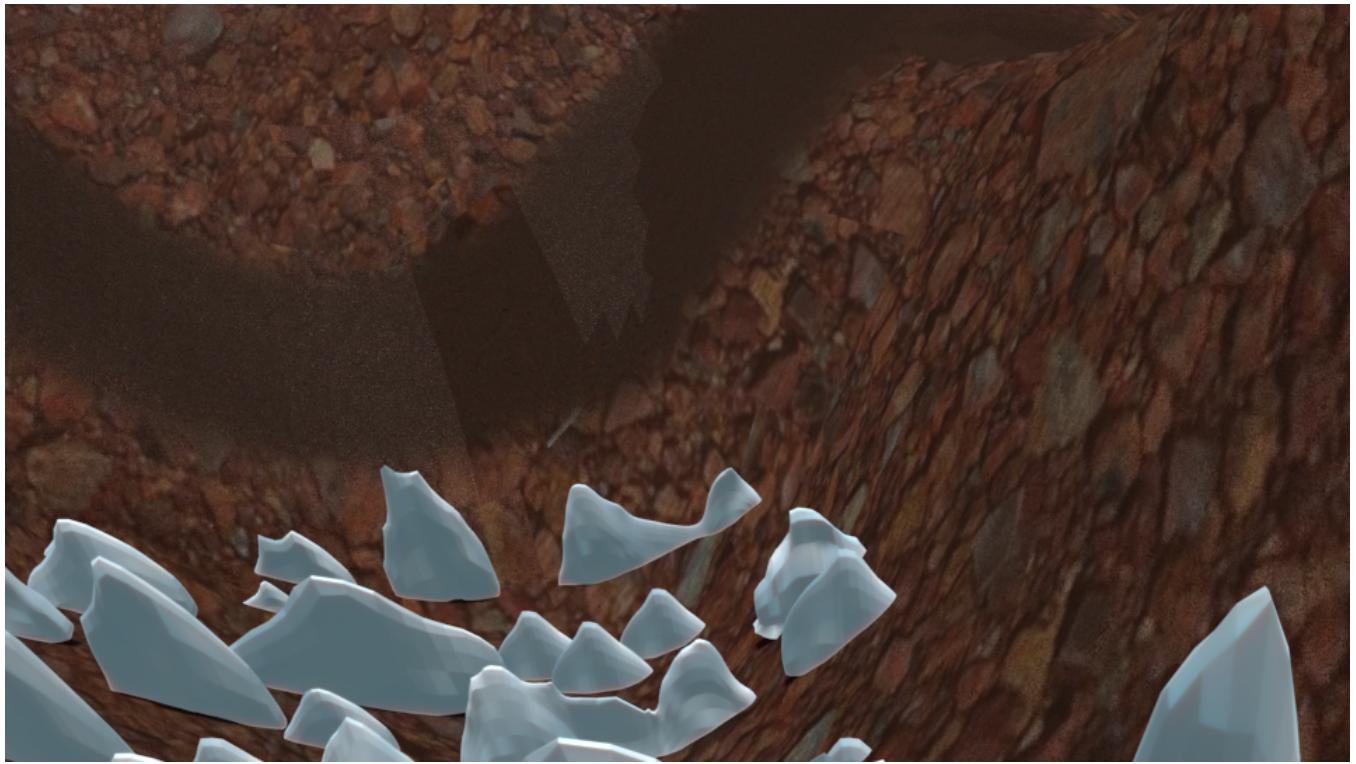
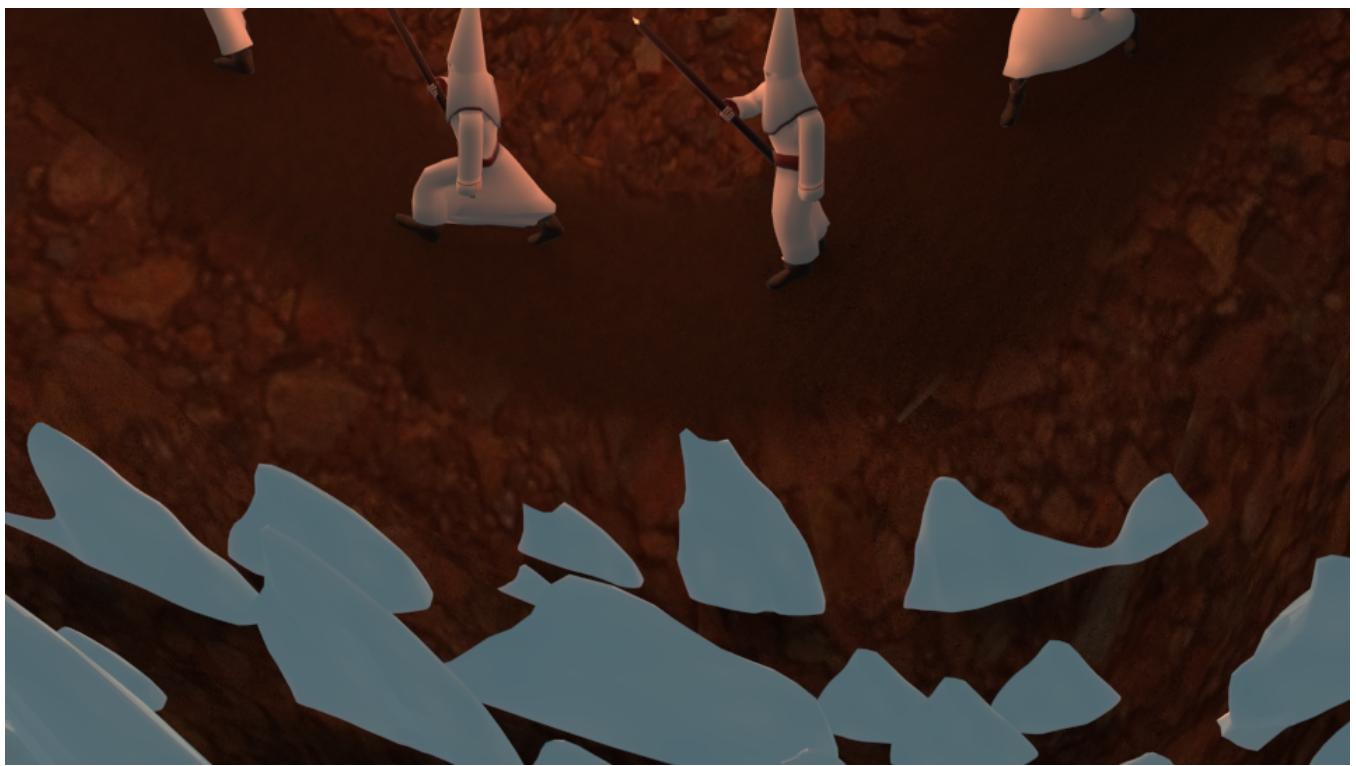
The result of the project is a scene in Blender containing skeletal animation and models of penitents. Including animated camera movement. The main output is therefore a video rendered in which it is possible to see a procession of penitents with large candle on the way under the formed penitents. All project files are available at <https://github.com/xchuki00/VIZa>.

## **Conclusion**

The resulting product is not bad, but it would like to improve the texture of the mountains and the animation of the walking of the Penitents. But overall, the result includes several techniques used, nodes, sculpt tools, simple lighting animated in time and skeleton animation for the movement of the Penitents. Overall, I learned a lot, each part could be more perfect, but then with this complexity of the scene, it might be a little bachelor thesis.

## List of figures





# Literatura

- [1] THEORANGEDUCK.COM. *Subdivision Modelling* [online]. theorangeduck.com, 21. 3. 2011 [cit. 2020-04-29]. Available at: <http://theorangeduck.com/page/subdivision-modelling>.