Either paper or digital maps have limited capacity. Obviously, if too many objects are put on the map it becomes chaotic and unreadable. In order to avoid this high object density, a process called generalization is needed. Until now the generalization was made by the human interaction and intelligence. This paper introduces an automatic generalization technique based on digital elevation models and digital filtering methods. All map objects such as parcels, roads, rivers are on the Earth surface. If we change this surface by digital filters like low-pass filters the proper object density is produced. In the following the digital filtering will be defined first and its general behavior will be described. Further digital filters can be applied well, such as edge preserving filters. This paper deals with the application of smoothing.

2.1 Outline of the sampling theorem

If we apply the sampling process to a surface, the sampling tool will be like a yogi’s nailed bed (Fig. 5). Let us have a r sampling distance for defining a grid. Every grid point has \( x, y, z \) coordinates. This is the digital elevation model (DEM). The resolution of the DEM depends on \( r \). As mentioned above every object on the Earth properly defined by a grid. There are other ways of representing the terrain elevation (Fig. 7, 8), but the current one is precisely adjustable for different scales, and consequently for the automatic generalization.

2.2 The Square function and its Fourier transform

Let us define the square function, which is very important in this context

\[
G(f) = \sum_{k=-\infty}^{\infty} \delta(t-k\tau)
\]

where the Dirac is the following:

\[
k(t)=0, \quad \text{if } t \neq 0 \text{ and } \sum_{t=0}^{\infty} t = 1
\]

Remember the definition of the convolution of \( f(t) \) and \( g(t) \) functions:

\[
(f * g)(t) = \int_{-\infty}^{\infty} f(r)g(t-r)dr
\]

Let us look at the following formula which is essential in understanding of the sampling process:

\[
G(f) = G(f + 2\pi f_0) = \int \frac{G(f)}{1 + 2\pi f_0 f}
\]

The convolution of two functions in the time domain is equal to the product of their Fourier transform in the frequency domain, and vice versa. Let us investigate the spectra of the analogue and the digitized functions. Let \( G(f) \) denote the spectra of the analogue, and \( G_d(f) \) the spectra of the digitized function. According to the properties of the Fourier transform of the Dirac function and the convolution, the spectra of the digitized (sampled) function is

\[
G_d(f) = G(f) + \sum_{k=1}^{\infty} \delta(f-kf_0)
\]

If the sampling period can be distance dimension, if we have \( k \) values of sinc function with proper argument in arbitrary arguments, in that place.

4. Conclusion

Some image processing technique such as low-pass filtering is a very good method for automatic generalisation of the Earth surface, consequently each map – a grid tile – has its proper background. Let us have a look at the following formula which is essential in understanding of the sampling theory the downsampling produces smoothed dataset. Instead of using simple low-pass filters on the original database downsampling produces smoothed digital elevation model also, but smaller sized database.

References