THE ANNALS OF "DUNAREA DE JOS" UNIVERSITY OF GALATI
FASCICLE XIV MECHANICAL ENGINEERING, ISSN 1224-5615
2007

THE MECHANICAL LOW FREQUENCY SIGNAL RECONSTRUCTION BY IT'S SPECTRAL COMPONENTS

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ABSTRACT

This paper is a point of view of a new way of signal reconstruction through it's spectral components. Sampling theory is analyzed from different perspectives, what means if for technical reasons the time can't be sampled in intervals below Δt_{min}, the discrete signal is known precisely up to the harmonic $\omega_c = \pi/\Delta t_{min}$. Upon reconstruction the ω_c frequency is no longer relevant, the shorter the signal duration is.

1. Introduction

Macroscopically speaking, a real natural signal is considered continuous and can be processed by the means of the continuous analysis instrumentation. To analyze such a signal with modern equipment, containing a specifically programmed numeric processor, the signal needs to be first recorded and stored in the computer memory in a numerical form, by a discrete function, with values determined on a periodical manner, as described in figure 1. In other words the $f(t)$ continuous signal, manifesting on a continuous domain of the independent variable which is time becomes a discrete signal

$$f(t),\quad t \in [t_1, t_2] \rightarrow f_i(t_i),\quad i = 1,2,\cdots,n,\cdots ,$$

which has values that are only known at the t_i moments.

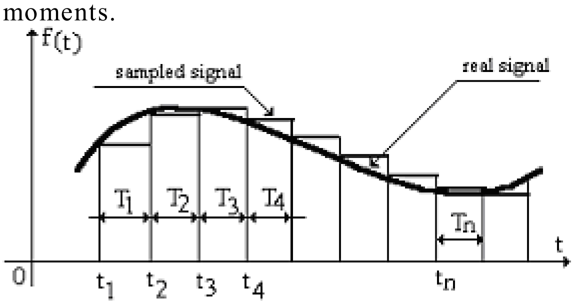

Figure 1 The continuous signal versus the sampled one

2. Signal sampling

When doing the signal sampling one must take many elements into account: aside issue related to the technical means for doing the sampling, the most important aspect has to do with the need to reconstruct the original continuous signal (and only that signal) out of the samples at any given time.

In the example in figure 1, only the independent variable (which is time) was sampled while the signal value can have any value within a continuous interval.

As these values go smaller, tending for $T_i \rightarrow 0$ it becomes continuously difficult to find different values for the sampled values and thus of the discrete function: $f_i(t_i)$, it is thus obvious that after a given limit of the sample interval the signal has a unique representation through sampling. It is therefore easy to demonstrate that a signal can be adequately represented through sampling, not only for $T_i \rightarrow 0$ but also when the sampling limit is smaller than a predefined limit. It is in fact the sampling theory we're talking about.

3. About the spectral functions

The sampling theory is only applicable for the discrete analysis of the independent variable (time) and starts from the premises that at any given moment t_i one can precisely determine the exact value of the signal, that is not taking into account the sampling of the function (when $df = 0$).

Whether we refer to a periodic or non-periodic signal whose harmonic specter[1] has a superior limit f_C, over which the amplitude of all harmonics is zero[2]. The specter of the $f(t)$ signal is determined on the ground of the Fourier transformation

$$G(j\ \ ) \qquad f(t)e^{\ j\ \ t}dt$$