Introduction

The DFT, which we studied in the previous module, is not only a mathematical analysis formula but also a practical algorithm that we can compute numerically (that is, with a computer) on any given finite-length data set. As such, the DFT is an invaluable tool in all practical signal processing applications.

The DFT, however, covers only one of the possible types of discrete-time signals that we have seen, the finite-length case. In this module we will briefly talk about the DFS, which is a straightforward extension of the DFT to periodic signals, but, more importantly, we will introduce the Fourier analysis tool for infinite-length sequences, the so-called DTFT. This transform, as opposed to the algorithmic DFT, is a purely mathematical tool but one that will allow us to derive general results for all types of signals in the rest of this course.

This module is a bit more abstract and mathematical than the previous ones, but necessary to lay the basis for applications to come such as filtering.

To begin with, in the previous module we remarked that, if we let the DFT synthesis run beyond $N-1$, we obtain a N-pediodic signal $x[n+N] = x[n]$. Likewise, the analysis formula produces also a N-periodic series of Fourier coefficients. Thus the concept of DFT naturally extends to periodic sequences and we will talk about discrete Fourier series (DFS) in the case of periodic sequences.