A.7 Impulses

Mechanics defines the impulse (momentum) p as the product of mass and velocity: $p = mv\cdot$. This definition is not used in the present book - instead, the definition of **systems theory** is used: an impulse is a signal of basically short-duration, the signal being either non-zero for a short time, or zero for the remainder of the time, or converging so fast to zero that the signal is practically zero during the predominant part of the observation period. The terms "basically", "predominant" and "practically" can only be specified in the individual case. The magnitude of **causal** signals is identical to zero on the negative part of the time axis**,** while acausal signals are non-zero even for such “negative locations on the time-axis”.

In systems theory, the symbol p stands for the complex **angular frequency**:

$$p = \sigma + j \cdot \omega = \sigma + j \cdot 2\pi f; \;\; j = \sqrt{-1}\,.$$

The magnitude of a **bipolar impulse** changes polarity (its sign) at least once, while a **unipolar impulse** does not cross the zero line.

The **Dirac impulse** $\delta\,(t)$ is a theoretical signal that cannot occur in practice but is still used as a standard signal for (theoretical) system excitation. $\delta(t)$ is always zero except at t = 0; here $\delta(t)$ is infinite [Marko, Küpfmüller]. If, without further specification, only the "impulse" is mentioned, either a Dirac impulse is meant, or - usually occurring in measurements - a unipolar approximation for it.

A signal in which short-duration pulses occur in periodic repetition is called a **pulse** (e.g. square-wave pulse, Dirac pulse).

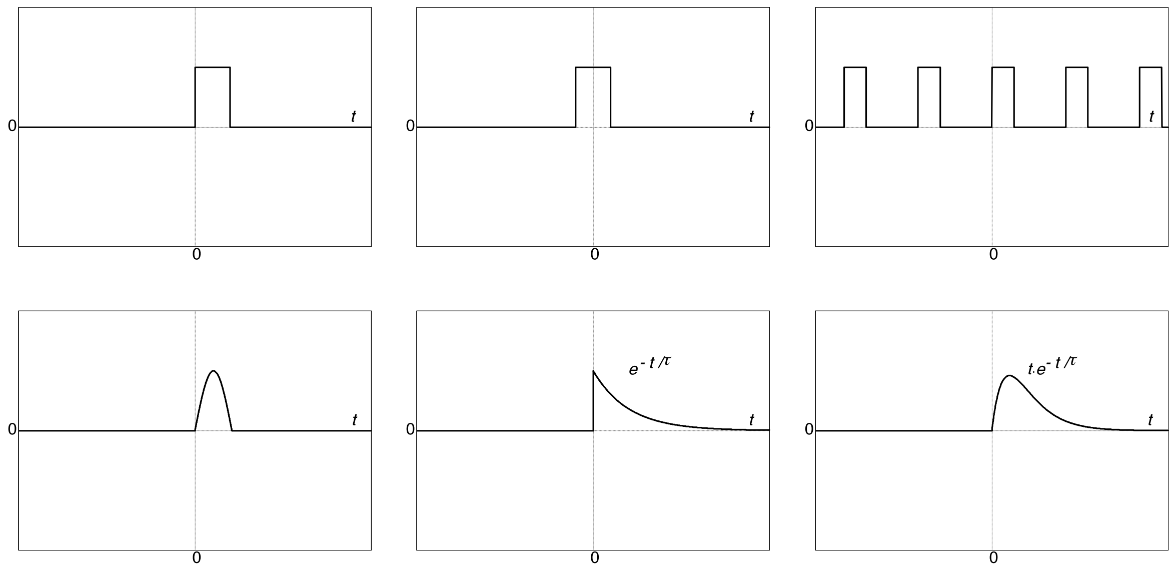

Fig. A.7.1: Pulse shapes: causal rectangular pulse, acausal rectangular pulse, square pulse; (top, left to right). Causal sine half-wave pulse, causal exponential pulses; (bottom, left to right).

