The RWP antenna receives the backscattered electromagnetic wave and converts it into a measurable voltage or current signal at the antenna output port, which contains all the information regarding the measurement. This signal S is proportional to the integral of $\mathbf{E}_s$ over the antenna aperture F:

$$S(\mathbf{r},t) = \iint_F \mathbf{E}_s(\mathbf{r}+\rho,t)d\mathbf{f}$$

where

$d\mathbf{f} = \mathbf{f}_A(\rho)d^2\rho$ includes the antenna radiation pattern.

The receiver signal at the antenna output port of a pulsed single-frequency RWP is often assumed to follow the standard model assumption of a

- continuous
- real-valued
- Gaussian random
- narrowband
- (potentially) large dynamic range
- two component

process, which can be written as

$$S[n] = I[n] + N[n],$$

where $I[n]$ is due to atmospheric scattering and $N[n]$ is the ubiqitous noise. This model is the foundation of the classical signal processing methodology for RWP. However, the model is incomplete in the sense that it does not contain all real-world effects like clutter or radio interference. More precisely,

$$S[n] = I[n] + N[n] + C[n],$$

where $C[n]$ is an additional (clutter) component with possibly very diverse properties, depending on its origin. Taking this clutter component into account, the real-world RWP signal may become

- multi-component
- non-stationary

The first property is due to the possibility of different collectively acting scattering and interference mechanisms. The second is due to non-stationary clutter echoes (mainly bird, airplane and lightning echoes), which are more or less frequently observed in practice.

Ignoring this clutter term leads to errors in parameter estimation, the severity of which varies with the particular clutter type, strength and duration.

More details can be found in Lehmann and Teschke (2008).

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