Radar Echo Simulation and Corruption Description

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Table 1: Radar Signal Parameters

Parameter	**Symbol**	**Value / Range**	**Unit**
Signal waveform	LFM	-	-
Sampling rate	f_s	256	MHz
Total length of received signal	L	512	samples
Effective echo length	N	128–256	samples
Pulse width	T	N/f_s	seconds
Carrier frequency	f_c	$f_s/8$–$f_s/4$	Hz
Bandwidth	B_{w}	$f_s/16$–$f_s/4$	Hz
LFM modulation slope	k	B_{w}/T	Hz/s
Target distance	R_0	10–140	m
Target velocity	v	1–20	m/s
Random corrupted length	L_{rc}	$N/5$–$N/4$	samples

To support waveform recovery experiments, we simulate a radar echo dataset containing physically interpretable corrupted LFM signals. Each sample is randomly generated based on the radar parameters listed in Table 1. The signal delay $\tau = 2R_0/c$ determines the echo starting point in the received sequence. Based on these parameters, we calculate the received waveform $s_{rx}(t)$ and simulate both deterministic and stochastic degradation.

Specifically, the corrupted segment is randomly inserted into the received waveform. The corrupted region is either zeroed out or blended with additive Gaussian white noise (AWGN), with signal-to-noise ratio (SNR) set to a fixed value (e.g., 8 dB). The corrupted waveform $\tilde{s}_{rx}(t)$ is then formed. Each degraded waveform contains two key features: the clean waveform $\mathbf{L}_{\mathrm{wave}}$ and the corresponding corrupted TFR $\mathbf{X}_{\mathrm{wave}}$.

We generate 2000 radar waveform samples and use an 80%/20% split for training and testing. Each sample is processed using STFT and quadrant division (as described in Eq. 5 and 7), resulting in a TFR tensor of size $\mathbb{R}^{2000\times4\times512\times512}$ and its associated waveform tensor $\mathbb{R}^{2000\times1}$. These are fed into the DTFIRNet for joint TF domain reconstruction, aiming to

enhance signal recovery accuracy. The occlusion-induced corrupted radar echo dataset, constructed for low-altitude UAV monitoring scenarios, has been contributed to IEEE DataPort.