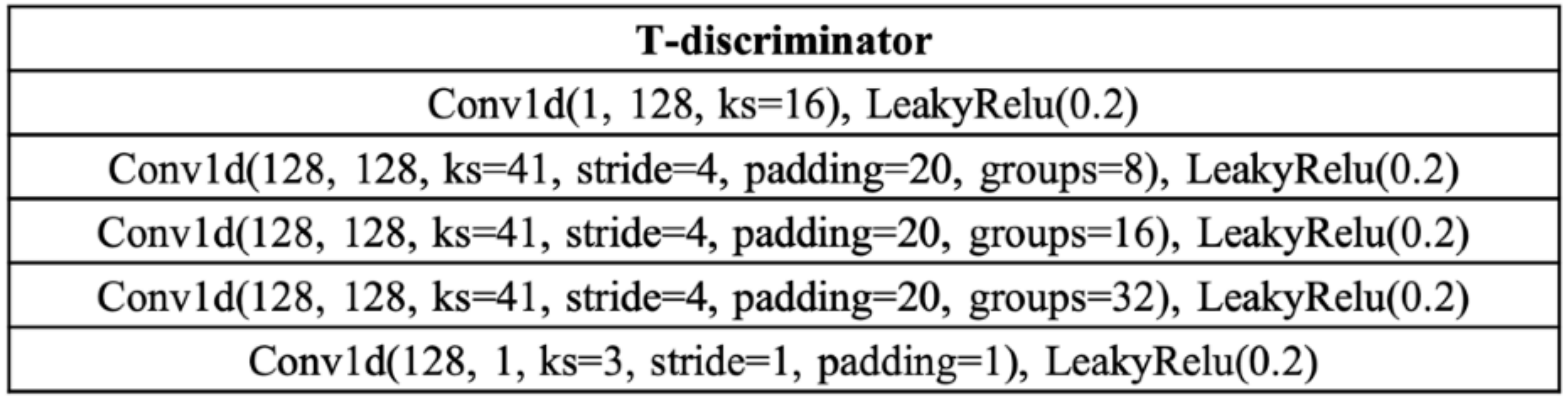
VoiceFixer

TFGAN Vocoder - Training - Discrminator Losses

- Loss Function: $\mathbb{L}_{syn} = L^T + L^F + \lambda_1 L^D$
- Discriminator Losses:
  - $D(\hat{s}) = D^{T\_sub}(\hat{s}) + D^F(\hat{s}) + \sum_{r=1}^{4} D_r^T(\hat{s})$
  - $L^D = \min_G \max_D (\mathbb{E}_s(log(D(s))) + \mathbb{E}_{\hat{s}}(log(1 - D(\hat{s}))))$.

Table.5 The architecture of time domain discriminator



T-discriminator
Conv1d(1, 128, ks=16), LeakyRelu(0.2)
Conv1d(128, 128, ks=41, stride=4, padding=20, groups=8), LeakyRelu(0.2)
Conv1d(128, 128, ks=41, stride=4, padding=20, groups=16), LeakyRelu(0.2)
Conv1d(128, 128, ks=41, stride=4, padding=20, groups=32), LeakyRelu(0.2)
Conv1d(128, 1, ks=3, stride=1, padding=1), LeakyRelu(0.2)

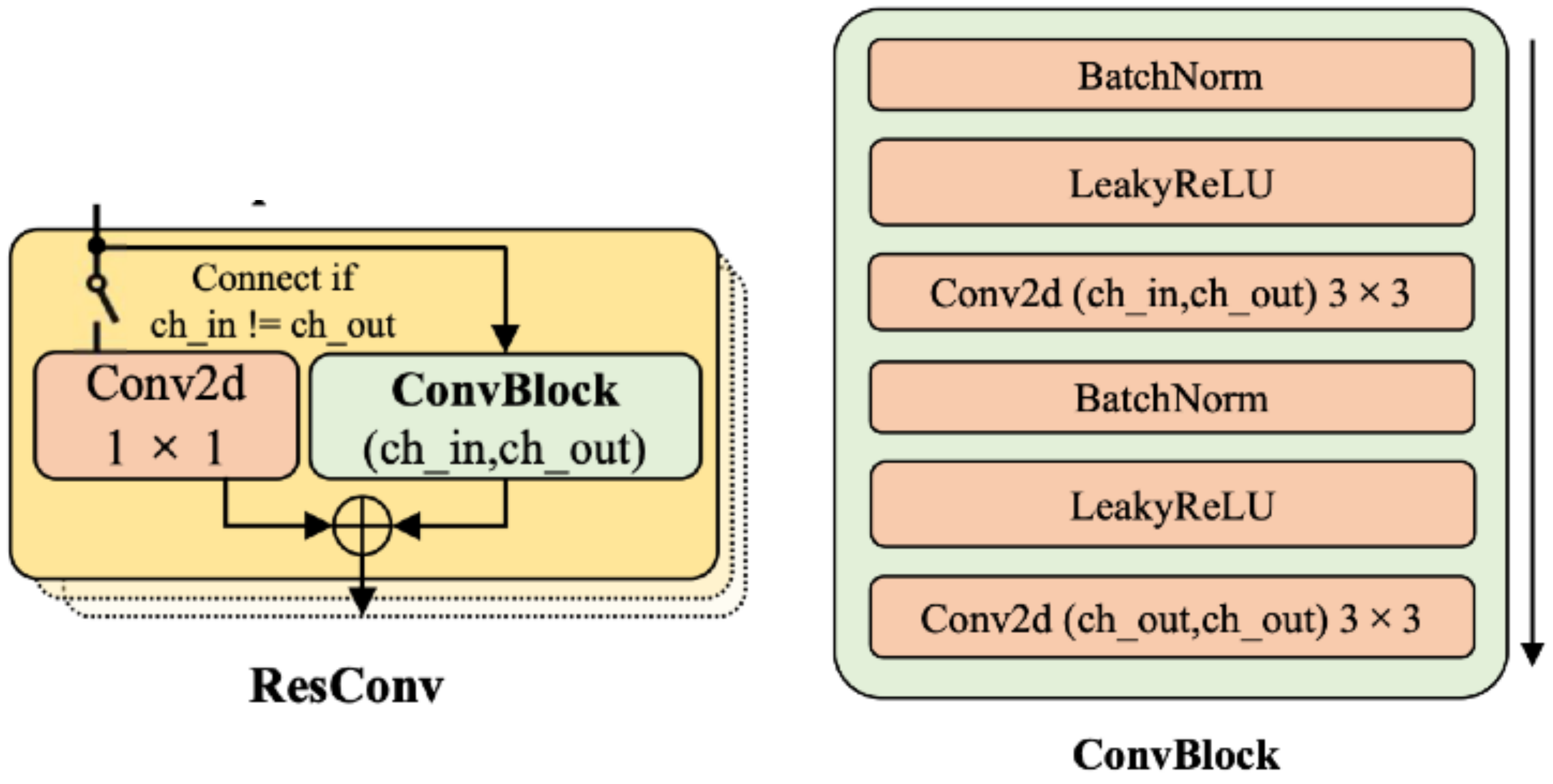
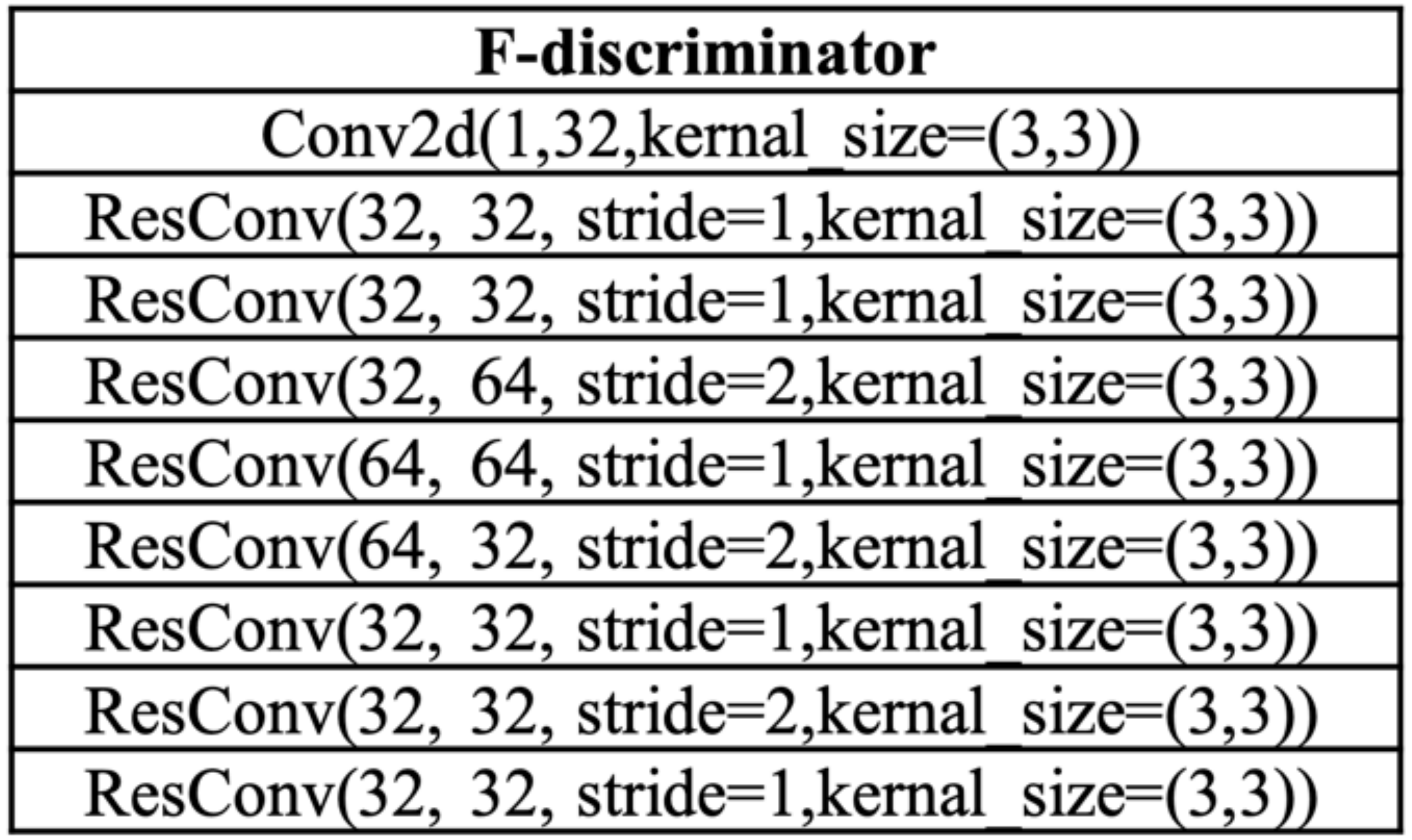


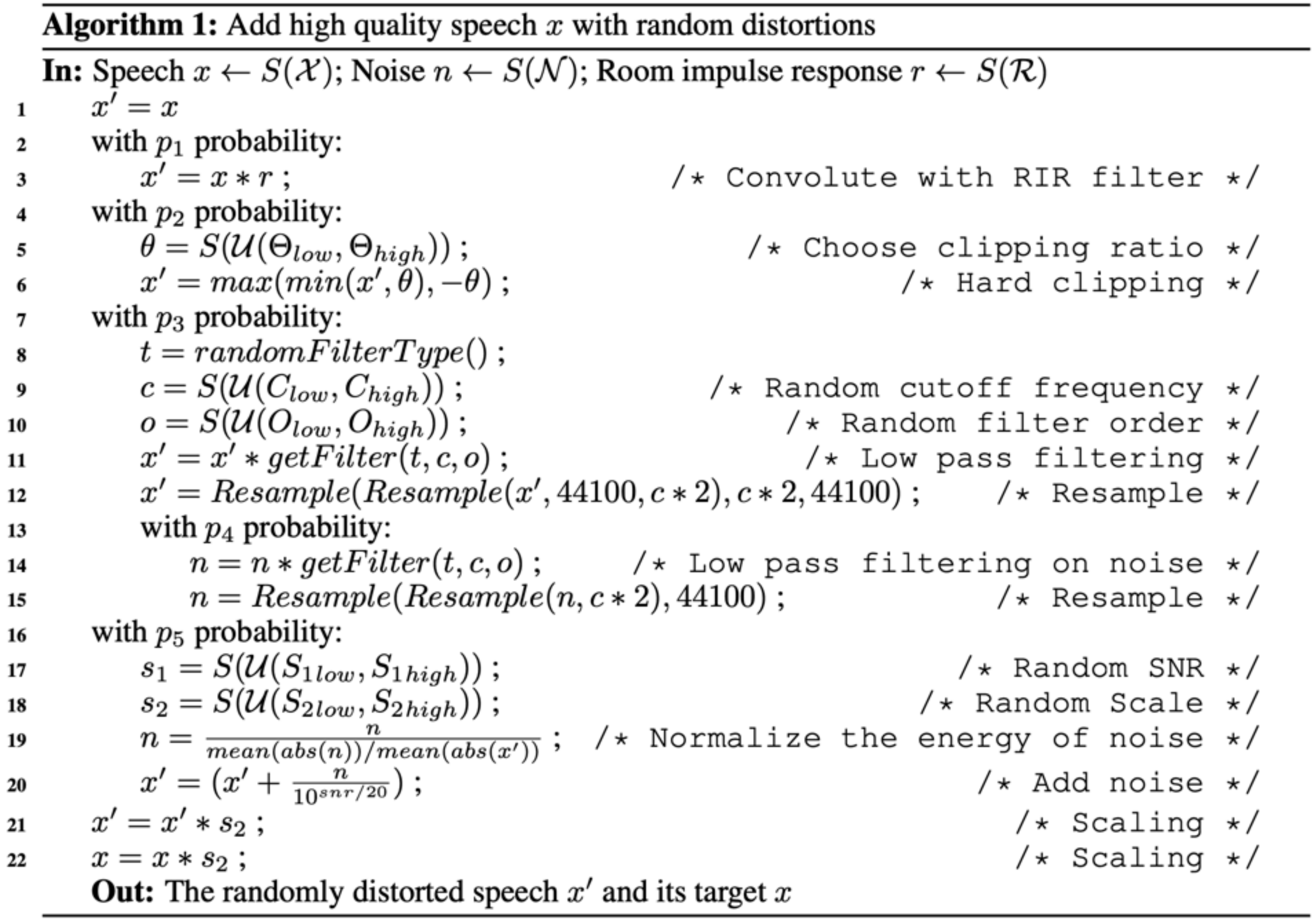
Table.6 The architecture of frequency domain discriminator



F-discriminator
Conv2d(1,32,kernal_size=(3,3))
ResConv(32, 32, stride=1,kernal_size=(3,3))
ResConv(32, 32, stride=1,kernal_size=(3,3))
ResConv(32, 64, stride=2,kernal_size=(3,3))
ResConv(64, 64, stride=1,kernal_size=(3,3))
ResConv(64, 32, stride=2,kernal_size=(3,3))
ResConv(32, 32, stride=1,kernal_size=(3,3))
ResConv(32, 32, stride=2,kernal_size=(3,3))
ResConv(32, 32, stride=1,kernal_size=(3,3))

Experiments

Training data distortion simulation



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Algorithm 1: Add high quality speech $x$ with random distortions
In: Speech $x \leftarrow S(\mathcal{X})$; Noise $n \leftarrow S(\mathcal{N})$; Room impulse response $r \leftarrow S(\mathcal{R})$
    $x' = x$
    with $p_1$ probability:
        $x' = x * r$ ;                                          /* Convolute with RIR filter */
    with $p_2$ probability:
        $\theta = S(\mathcal{U}(\Theta_{low}, \Theta_{high}))$ ;      /* Choose clipping ratio */
        $x' = max(min(x', \theta), -\theta)$ ;                            /* Hard clipping */
    with $p_3$ probability:
        $t = randomFilterType()$ ;
        $c = S(\mathcal{U}(C_{low}, C_{high}))$ ;                 /* Random cutoff frequency */
        $o = S(\mathcal{U}(O_{low}, O_{high}))$ ;                     /* Random filter order */
        $x' = x' * getFilter(t, c, o)$ ;                             /* Low pass filtering */
        $x' = Resample(Resample(x', 44100, c*2), c*2, 44100)$ ;      /* Resample */
        with $p_4$ probability:
            $n = n * getFilter(t, c, o)$ ;           /* Low pass filtering on noise */
            $n = Resample(Resample(n, c*2), 44100)$ ;                      /* Resample */
    with $p_5$ probability:
        $s_1 = S(\mathcal{U}(S_{1low}, S_{1high}))$ ;                           /* Random SNR */
        $s_2 = S(\mathcal{U}(S_{2low}, S_{2high}))$ ;                         /* Random Scale */
        $n = \frac{n}{mean(abs(n))/mean(abs(x'))}$ ;  /* Normalize the energy of noise */
        $x' = (x' + \frac{n}{10^{snr/20}})$ ;                                    /* Add noise */
    $x' = x' * s_2$ ;                                                           /* Scaling */
    $x = x * s_2$ ;                                                             /* Scaling */
    Out: The randomly distorted speech $x'$ and its target $x$
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Distortion simulation algorithm we used for general speech restoration.