Voice Conversion Survey

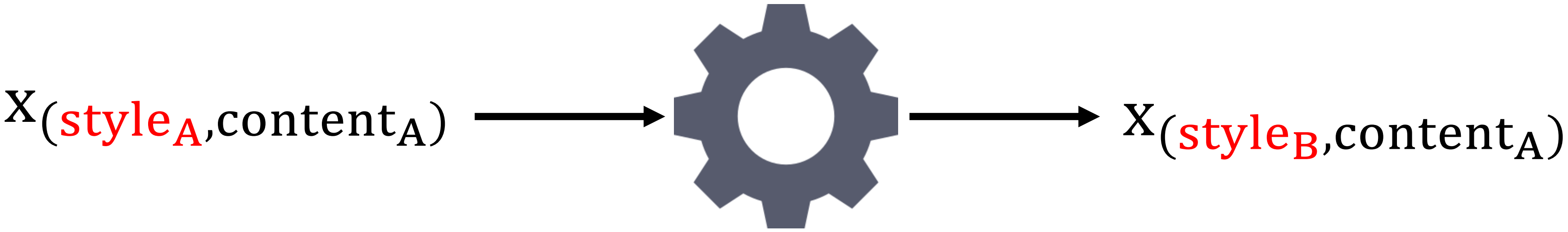
IELAB

정영석

Style Transfer

Style Transfer Task

- Definition of Style Transfer task
  - ✓ Style transfer is one of the most crucial task in Machine Learning. It is being studied regardless of field (Vision, NLP and audio).
  - ✓ Style transfer target to maintain the input data's contents and convert input data's style into other domains.



$$X_{(\text{style}_A,\text{content}_A)} \longrightarrow \quad \longrightarrow X_{(\text{style}_B,\text{content}_A)}$$

Voice Conversion

Voice Conversion

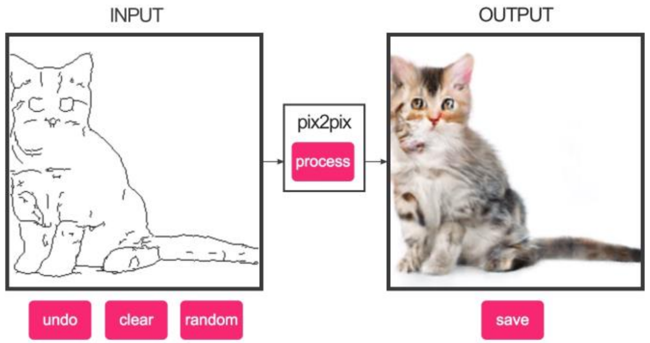
- Contents and Style information in Voice Conversion
  - ✓ In Voice Conversion task, people consider linguistic information as contents vector.
  - ✓ All information related to the speaker is defined as style information.
  - ✓ Convert A style Utterance to B style Utterance.

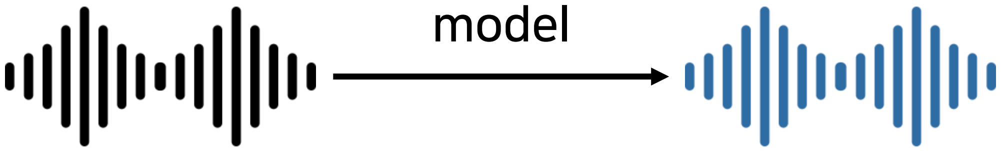
$$U_{(\mathrm{style}_{\mathrm{A}},\mathrm{content}_{\mathrm{A}})} \longrightarrow ⚙ \longrightarrow U_{(\mathrm{style}_{\mathrm{B}},\mathrm{content}_{\mathrm{A}})}$$

Voice Conversion

▪ The method for Voice Conversion

- The methods for parallel dataset.
  - ✓ Many traditional VC methods require parallel dataset.
  - ✓ This can be problematic since misalignment involved in parallel data can cause speech-quality degradation: thus, it require pre-screening method.
  - ✓ Moreover, collecting parallel data can be painstaking process in real application scenarios.





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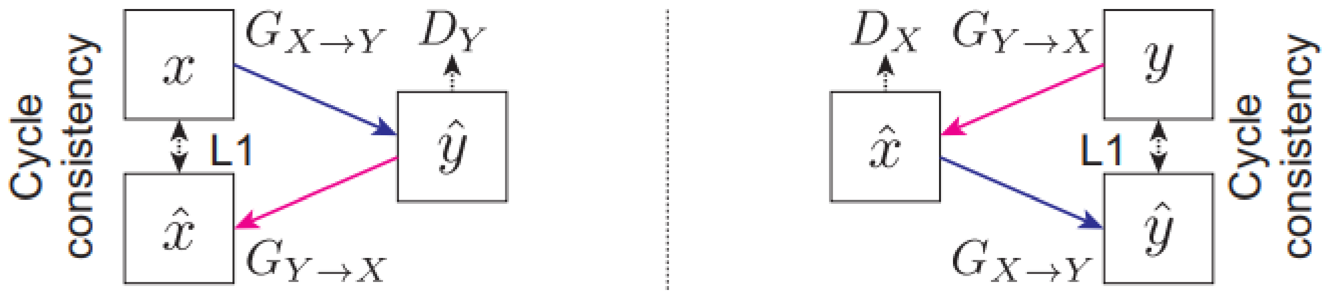
Voice Conversion

▪ The method for Voice Conversion

- The methods for non-parallel voice.
  - ✓ The fore mentioned methods have some limitation.
  - ✓ Some studies try to apply GAN-based model (CycleGAN, StarGAN, …) already utilized in Vision domain.
  - ✓ The GAN-based models are not appropriate for zero-shot conversion.



(a) Forward-inverse mapping

(b) Inverse-forward mapping

Fig. 1. Training procedure of CycleGAN

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Voice Conversion

▪ The method for Voice Conversion

- Disentangle features for zero-shot conversion

  ✓ Disentangle method

  1. Gradient reversal

  2. Sufficiently shallow bottleneck

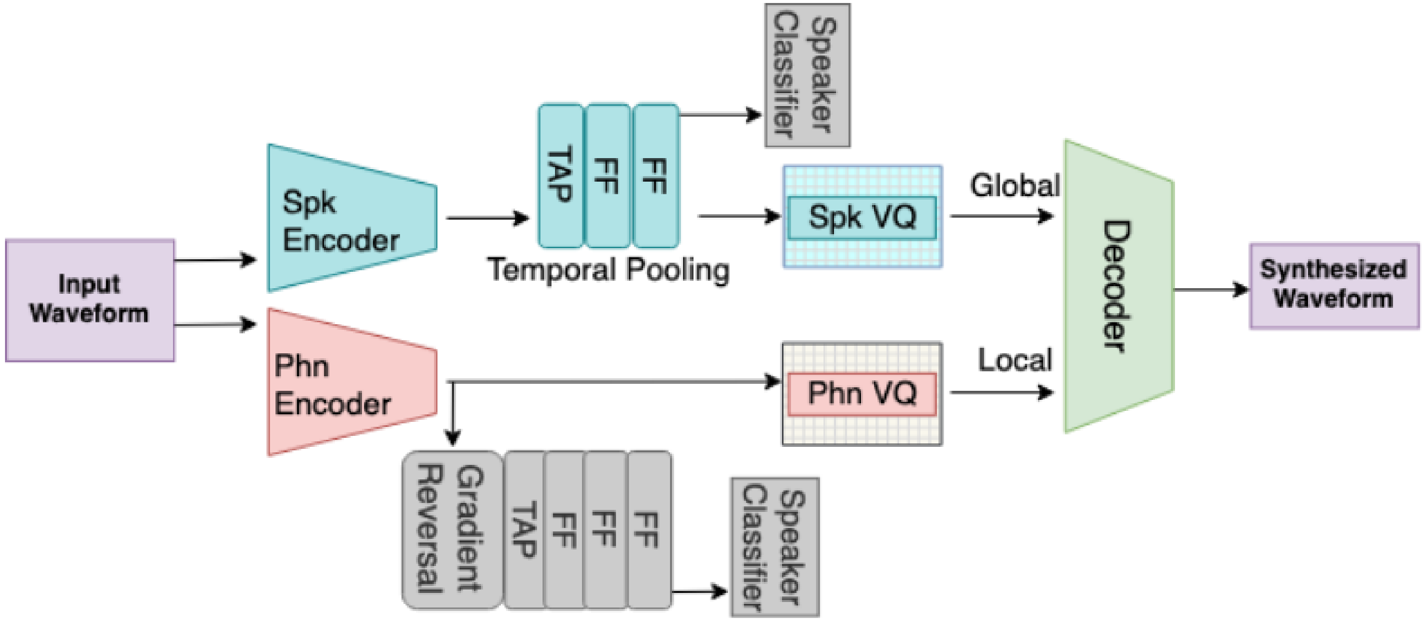
  3. Instance Normalization

  4. Minimize mutual information loss

Voice Conversion

▪ The method for Voice Conversion

- Disentangle features for zero-shot conversion (Gradient Reversal)



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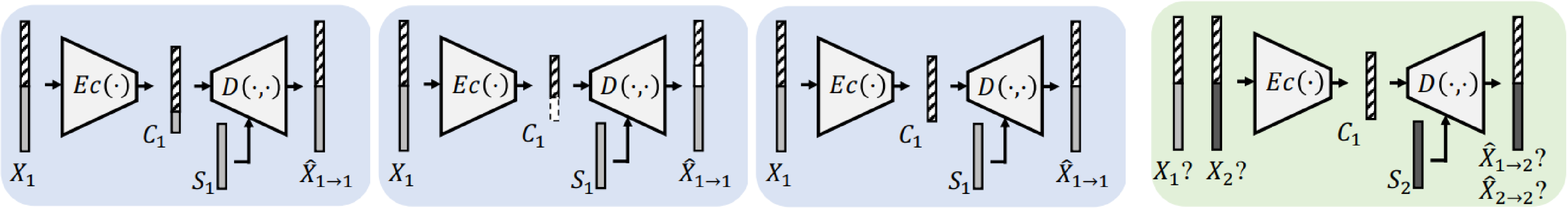
Voice Conversion

The method for Voice Conversion

- Disentangle features for zero-shot conversion (shallow bottleneck, etc.,)



(a) Bottleneck too wide (b) Bottleneck too narrow (c) Bottleneck just right (d) Conversion

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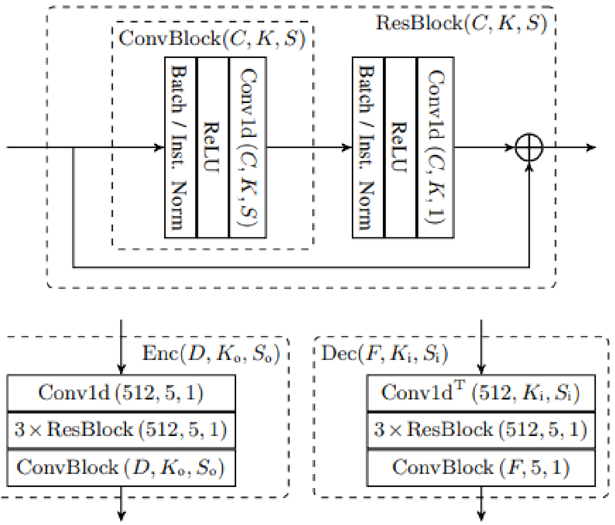
Voice Conversion

The method for Voice Conversion

- Disentangle features for zero-shot conversion (Instance Normalization)



$$\mu_{nc} = \frac{1}{HW}\sum_{j=1}^{H}\sum_{k=1}^{W} x_{ncjk}$$

$$\sigma^2_{nc} = \frac{1}{HW}\sum_{j=1}^{H}\sum_{k=1}^{W}(x_{ncjk} - \mu_{nc})^2$$

$$\hat{x} = \frac{x - \mu_{nc}}{\sqrt{\sigma^2_{nc} + \epsilon}}$$

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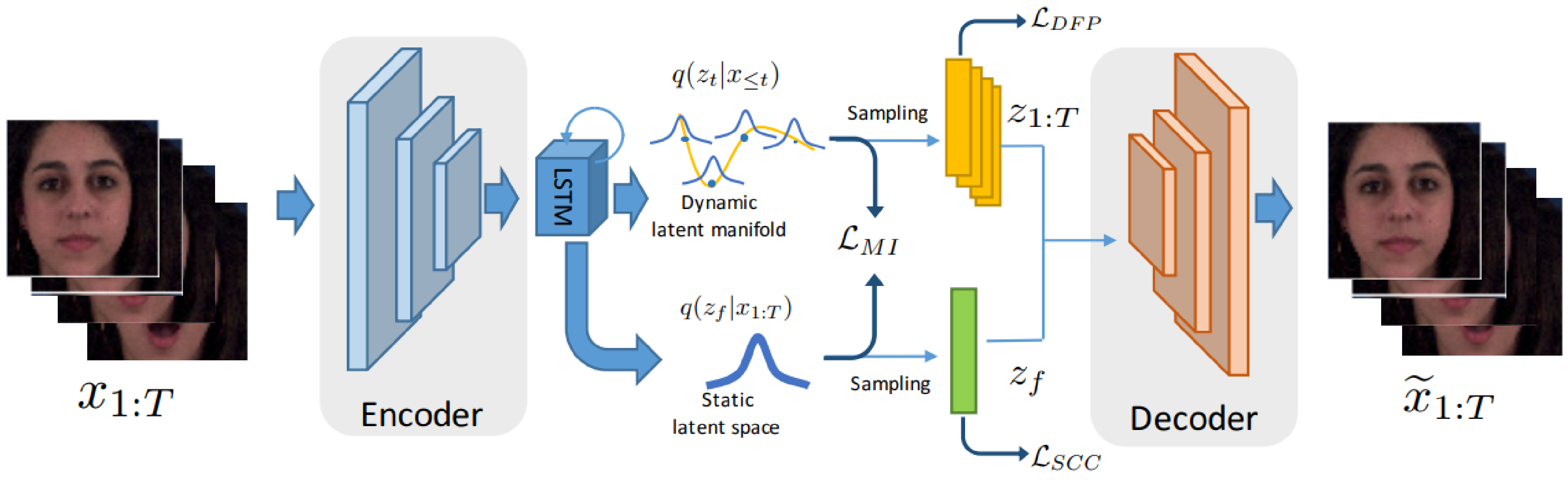
Voice Conversion

The method for Voice Conversion

- Disentangle features for zero-shot conversion (Minimize Mutual Information)



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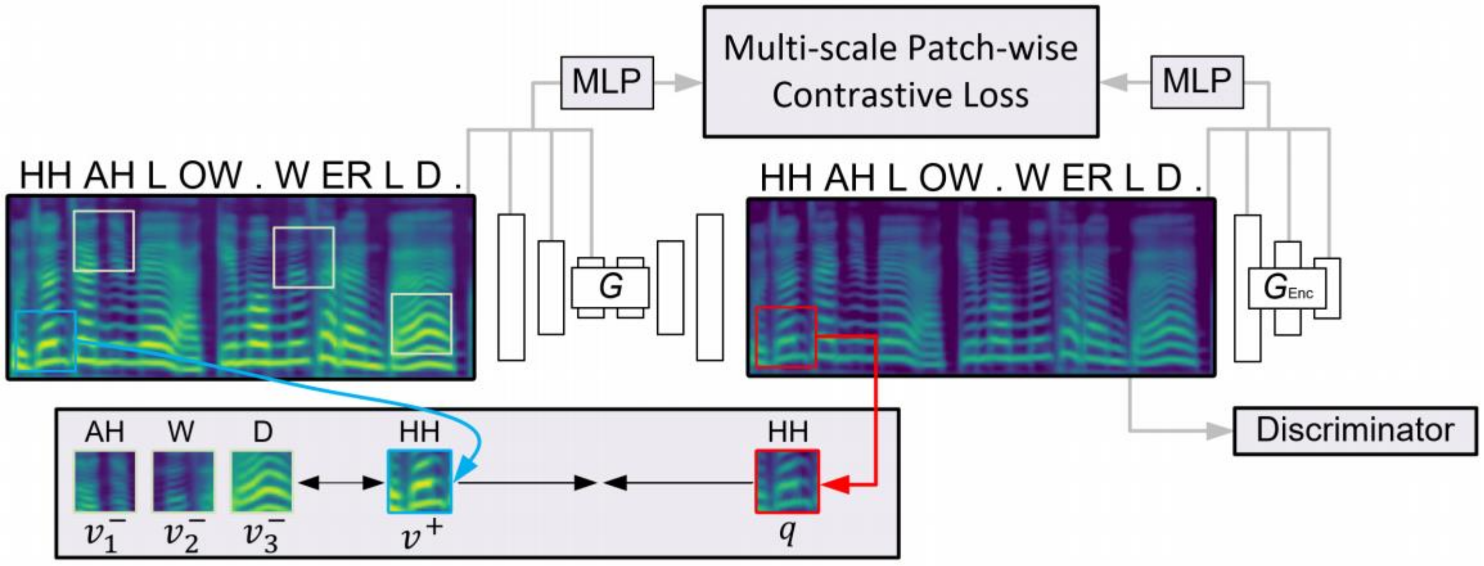
Voice Conversion

▪ The method for Voice Conversion

- Other methods…



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