### ッツチコヒー・テーマ Gait Anonymization Using Deep Learning Ngoc-Dung T. Tieu<sup>1</sup>, Huy H. Nguyen<sup>1</sup>, Junichi Yamagishi<sup>1, 2</sup>, Isao Echizen<sup>1, 2,3</sup>

 $\widehat{X}' = [\widehat{x'}_1, \widehat{x'}_2, \dots, \widehat{x'}_t]$ 

colorized by the color of the background

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## **Motivation**

Social internet users can upload and share the videos easily People in videos may be recognized by gait recognition systems because: • Gait has become a type of personal ID

• Gait can be recognized from a distance



**Generation phase** 

 $Y' = [y'_1, y'_2, ..., y'_t]$ 

Silhouette of the original gait

Silhouette of the anonymized gait

colorized by the color of

nearest pixel on the original gait

 $X' = [x'_1, x'_2, \dots, x'_t]$ 

Colorization

colorized by the color of

original gait

Background

### Methodology Training phase



**Pre-processing**: Extracting the contour of the silhouettes from the input video

Noise Generator  $G_N$ : Generating the noise in gait distribution from the random noise

**Discriminators:** Two discriminators  $D_S$  and  $D_T$  are to distinguish the real gait and generated gait in spatial and temporal domain

**Gait Generator G:** Generating the anonymized gait from original gait and the noise Loss function to train generator G  $L(G)=L_{Rec}(G)+\alpha*L_{Pur}(G)+L_{S}(G)+L_{T}(G)$ 

**Post-Processing: Colorizing** the anonymized gait with the color of the original gait

**Reference:** N.-D. T. Tieu, H. H. Nguyen, H.-Q. Nguyen-Son, J. Yamagishi, and I. Echizen, "Spatio-Temporal Generative Adversarial Network for Gait Anonymization," Journal *of Information Security and Applications*, vol. 46, pp. 307–319, June 2019

# **Objective**

#### Anonymizing gaits:

- The anonymized gaits cannot be recognized by the gait recognition systems
- The anonymized gaits still maintain the naturalness (shape, color, movement)

### **Results**

#### **Evaluate two metrics:**

- Naturalness: Using MOS test
- Success rate: The rate that the crecognition system fails to recognize the anonymized gait.

Two system are used: [S.Zheng et al. 2011], [Wu et al. 2018]  $\alpha$ =0.3

• Baseline: [Tieu et al. 2017]



- The proposed model overcomes the problem of the anonymized gaits generated with the baseline method looking less realistic because of head distortion
- The success rate with the proposed method was higher than that for the baseline method for both gait recognition systems





**Impact of** α:





