Online Object Recognition Using CNNbased Algorithm on High-speed Camera Imaging

Framework for fast and robust high-speed camera object recognition based on population data cleansing and data ensemble

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Introduction

Background: High-speed camera has high temporal information density and low latency, which make fast moving object tracking and controlling easier. How about recognizing?

Applications: mass production lines, autonomous vehicles, etc.

Problem: "low latency vs. high accuracy" with temporally dense images.

Introduction

Naive approach: random sampling. The accuracy depends on the quality of ROI images.



Proposed Framework

Population data cleansing based on the recognizabiliity score
 -> Remove low quality ROI images so as not to sample them.
 Data ensemble recognition with a single light-weight CNN model
 -> more accurate, and more stable.



Dataset

A novel dataset inspired by the visual inspection in the mass production.

- ✓ recorded by high-frame-rate camera (1000fps)
- ✓ Target objects moving at high speed
- Annotated with object categories(shapes, characters)



Experiment

1.Improving recognizability by Population Data Cleansing(PDC)



(a) training data

(b) test data

The lower recognizability scores become, the higher the chances to remove false ROI images become.

Experiment

2.Improving and Stabilizing Recognition Accuracy by Data Ensemble



(a) Mean accuracy vs. processing time (b) Minimum accuracy vs. processing time

<u>Ours is generally more accurate and definitely more stable</u> <u>than the conventional method.</u>

Experiment

3. Combination of the PDC and Data ensemble





(a) Mean recognition accuracy (b) Minimum recognition accuracy <u>PDC keeps or slightly improves and stably suppresses the</u> <u>repeatability errors, especially when the number of images is small.</u>

Why 1,000fps camera?

- <u>Small interframe displacement</u> makes object tracking easy (Even free-falling objects stay close to the position in the previous frame)
- Low latency enables real-time visual feedback control

Sorting system for high-speed moving objects using 1,000 fps camera

Conclusion

Proposed a novel object recognition framework for real-time applications with high-speed camera imaging
Constructed A novel high-frame-rate video dataset for visual inspection

- •Enabled CNN-based recognition against high-frame-rate timeseries data in real time
- •Showed More effective than existing approaches

Acknowledgment

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