Complex-Object Visual Inspection: Empirical Studies on A Multiple Lighting Solution

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Complex Object Visual Inspection

An object with unknown characteristics a-priori in terms of

- Shape
- Size
- Material
- Color
- Defect type
(Custom-Designed) Lighting Configuration

**Goal:** Highlighting most effectively the defect to be inspected

**Proposal:** One setup, four illumination conditions, three lighting techniques
Dataset

4 illumination * 3 camera exposure = 12 image per defect

**Goal:** maximize defect visibility
(achieved 99.2% visibility of over 5K defective regions)

Only 1 bbx per defect is enough to annotate all the 12 images.
Research Questions
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- Can different light conditions be considered as a natural data augmentation technique, or the resulting images are too correlated to actually bring any contribution during the model training?
Research Questions

- Does the proposed setup in fact outperform a conventional single illumination technique?
- Does availability of the multi-modal data in the training phase be used to improve the uni-modal testing performance?
- Can different light conditions be considered as a natural data augmentation technique, or the resulting images are too correlated to actually bring any contribution during the model training?
- Can inspection scenarios benefit from the multi-modal data availability also in the evaluation phase?
Empirical studies
Empirical studies

- Training
  - Single modality
- Training
  - All modalities
- Evaluation
  - Single modality
- Evaluation
  - All modalities

Baselines
Empirical studies

- Training
  - Single modality
- Evaluation
  - Single modality

- Training
  - All modalities
- Evaluation
  - All modalities

- Training
  - All modalities
  - Balanced data
- Evaluation
  - Single modality

Baselines
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Baselines
Final Results (Conclusions)

- Training
  - Single modality
  - All modalities

- Evaluation
  - Single modality
  - All modalities

Training
- All modalities
  - Balanced data

Evaluation
- Single modality

Training
- All modalities
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Evaluation
- Single modality

Baselines
Final Results (Conclusions)

Most effective modality

- **Training**
  - All modalities
- **Evaluation**
  - All modalities

- **Training**
  - All modalities
  - Balanced data
- **Evaluation**
  - Single modality

- **Training**
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Baselines
Final Results (Conclusions)

Most effective modality

Best results :) 
Most lengthy :( 

Better option?

Training
All modalities
Balanced data

Evaluation
Single modality

Training
All modalities
All data

Evaluation
Single modality

Baselines
Final Results (Conclusions)

Most effective modality

Best results :)  
Most lengthy :( 

Better option?

More modalities in training --> evaluation modality less important

Training
All modalities
All data

Evaluation
Single modality

Baselines
Final Results (Conclusions)

- Most effective modality
- Best results :)  
  Most lengthy :(  
  Better option?
- More modalities in training --> evaluation modality less important
- Training
  All modalities
  All data
- Evaluation
  Single modality

Baselines
Complex-Object Visual Inspection: Empirical Studies on A Multiple Lighting Solution

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