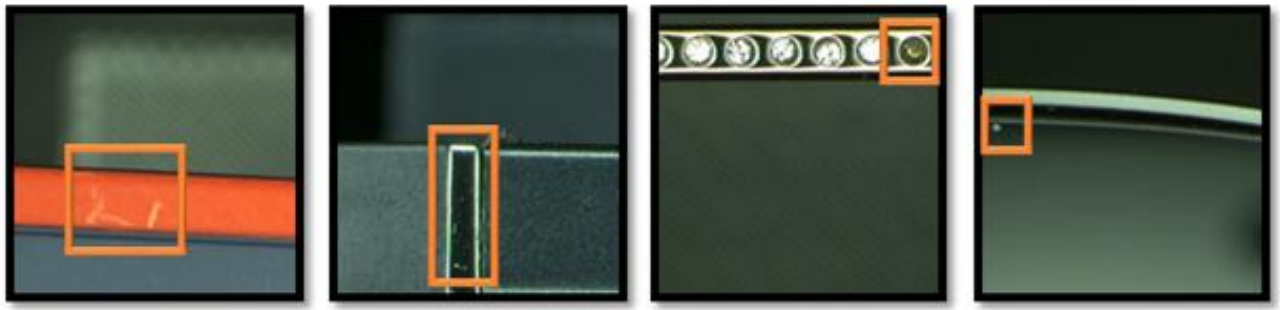
Complex-Object Visual Inspection: Empirical Studies on A Multiple Lighting Solution

Maya Aghaei, Matteo Bustreo, Pietro Morerio, Nicolo Carissimi, Alessio Del Bue, Vittorio Murino

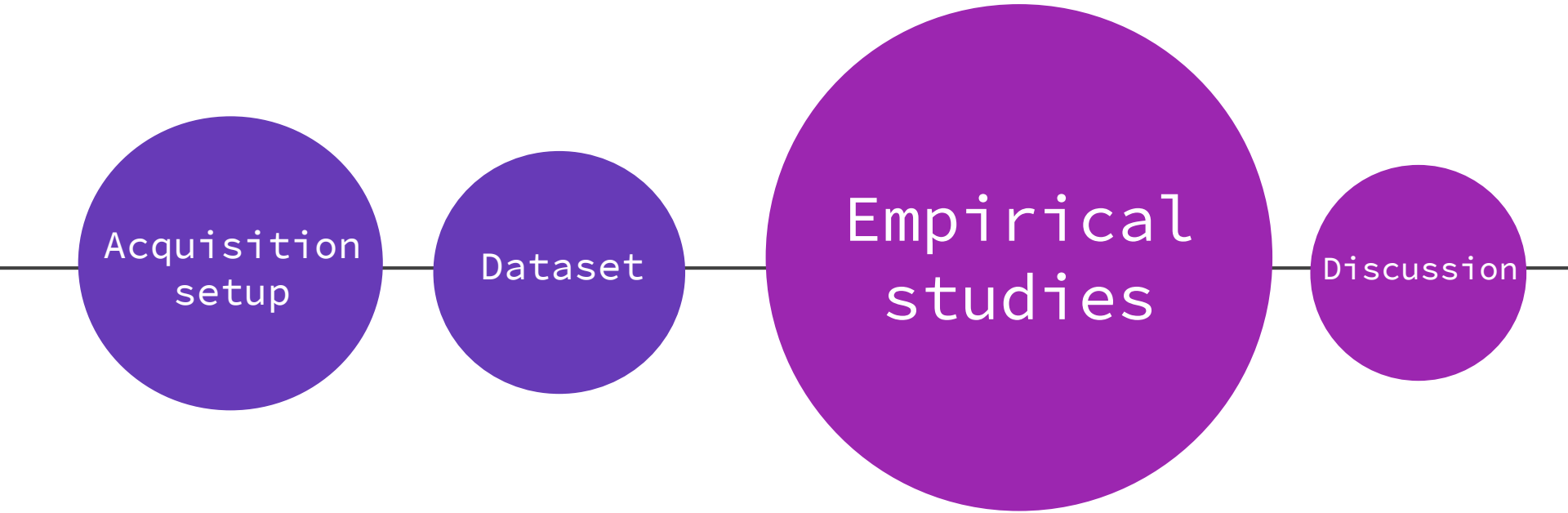
Complex Object Visual Inspection

An object with unknown characteristics a-priori in terms of

- Shape
- Size
- Material
- Color
- Defect type



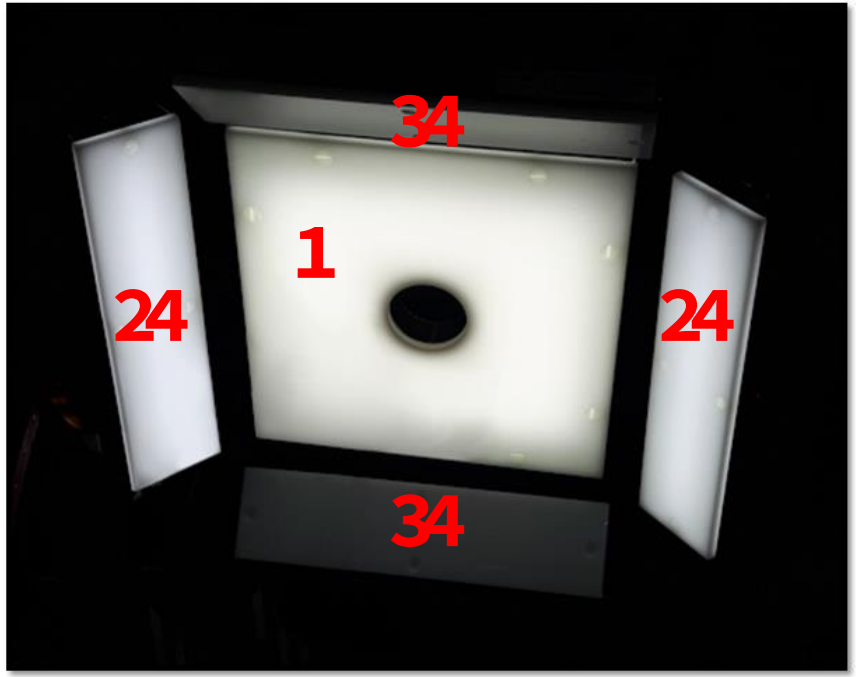
Outline



(Custom-Designed) Lighting Configuration

Goal: Highlighting most effectively the defect to be inspected

Proposal: One set up, four illumination conditions, three lighting techniques

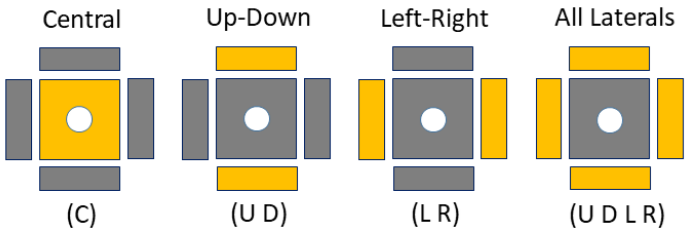


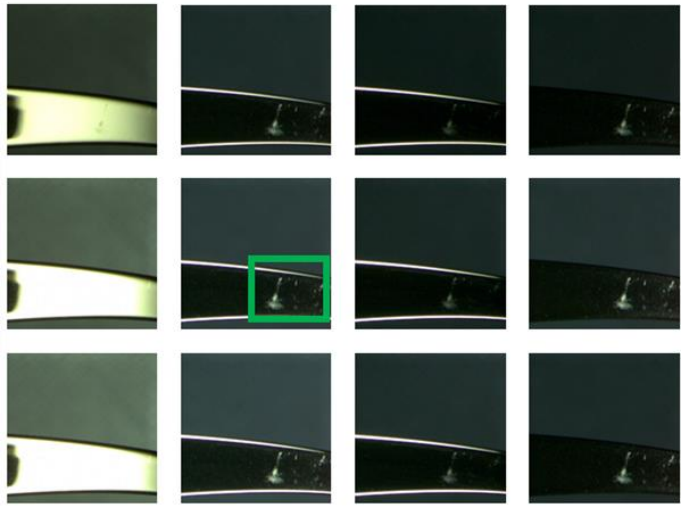
Dataset

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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- 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

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Training *Single* modality **Evaluation** *Single* modality	**Training** *All* modalities **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

Empirical studies

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

Baselines

Final Results (Conclusions)

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

Baselines

Final Results (Conclusions)

Most effective modality

Training
All modalities

Evaluation
All modalities

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?

Training
All modalities
Balanced data

Evaluation
Single modality

Training
All modalities
All data

Evaluation
Single modality

Baselines

Final Results (Conclusions)

Most effective modality

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Better option?

More modalities in training -->

evaluation modality less important

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