

A new taxonomy of existing data fusion algorithms for metrology

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Introduction

Data fusion has been increasingly popular in metrology in the past 10 years. It is frequently used for point cloud registration. The most common data-fusion algorithms for point cloud registration are Gaussian process (GP) algorithms, weighted least square (WLS) algorithms and machine learning algorithms.

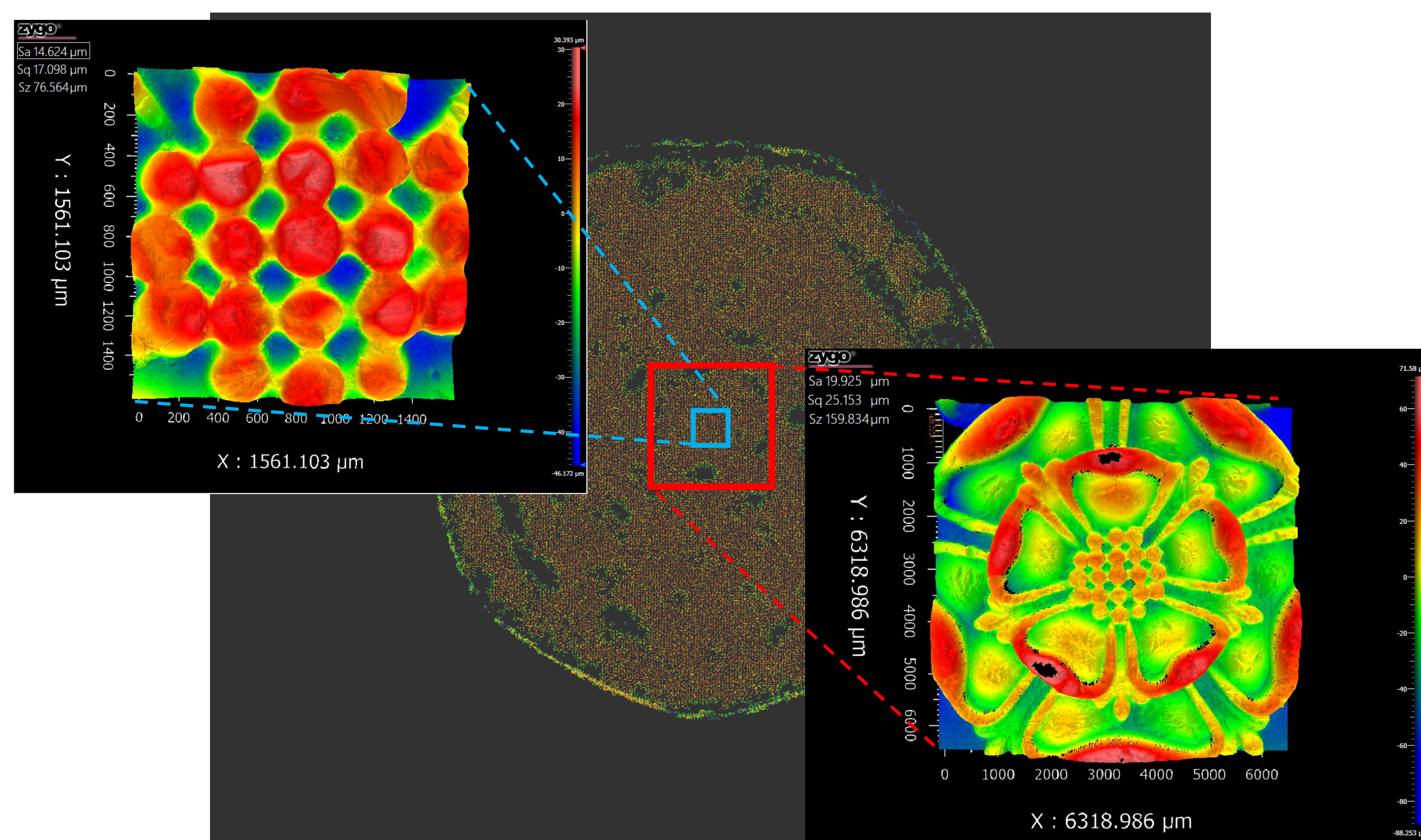


Figure 1 The point cloud of a 20 pence coin (background) and two point clouds of its surface texture (front).

GP Algorithms

$$GP(X) \sim N(\mu(X), K(X, X))$$

- Most popular in application.
- Model geometries with GP.
- Mature and convenient.
- Unknown whether it is effective for complex surfaces.

WLS Algorithms

$$z = Hx + \varepsilon$$

- Model geometries with linear WLS calculation.
- Easy to implement.
- But not suitable for fusing complex datasets.

Machine Learning

- A new family of algorithms in metrological research.
- Has displayed good potential with its powers in other scenarios, e.g. autonomous driving and face recognition.
- Can detect geometric features autonomously after being programmed by user.

User-dependent Algorithms

- Model the geometries of a surface with GP or WLS formulae.
- Have to be programmed by the user before running.

User-independent Algorithms

- No governing mathematical expression necessary.
- After being programmed, the model can recognise geometric features autonomously.

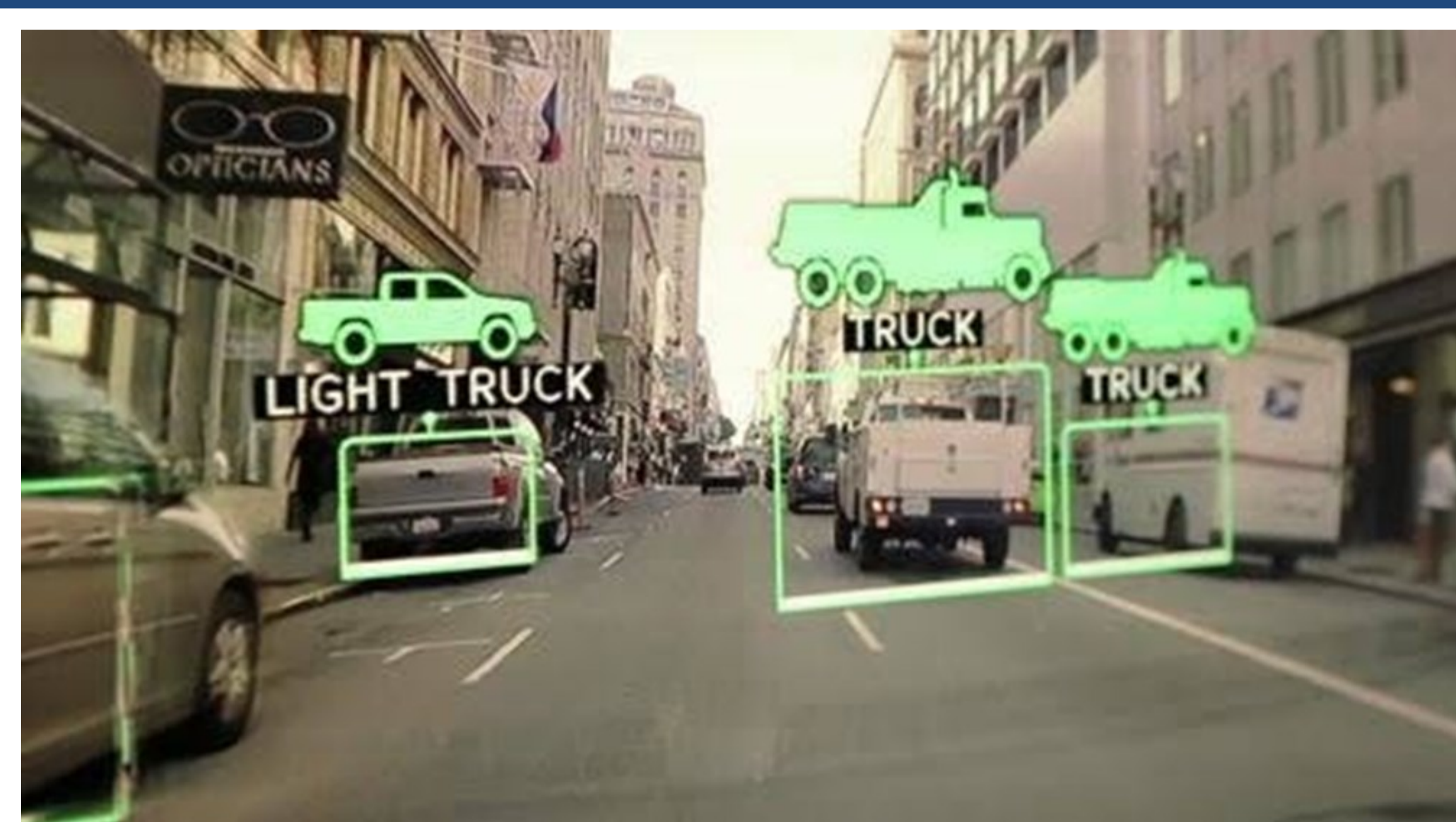


Figure 2 Vehicle classification in autonomous driving [1]

Future Work

- Use of user-independent methods (e.g. machine learning) in data fusion.
- Develop machine learning algorithms for both object classification (figure 2) and location.

References

[1] Güngör C, Zengin K 2017 A survey on augmented reality applications using deep learning GE-Internat. J. Eng. Res. 5

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