Low-Cost 3D model acquisition for rapid accident investigation

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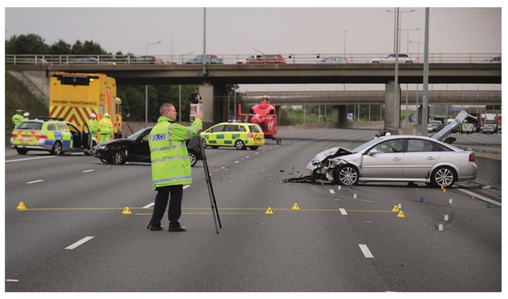
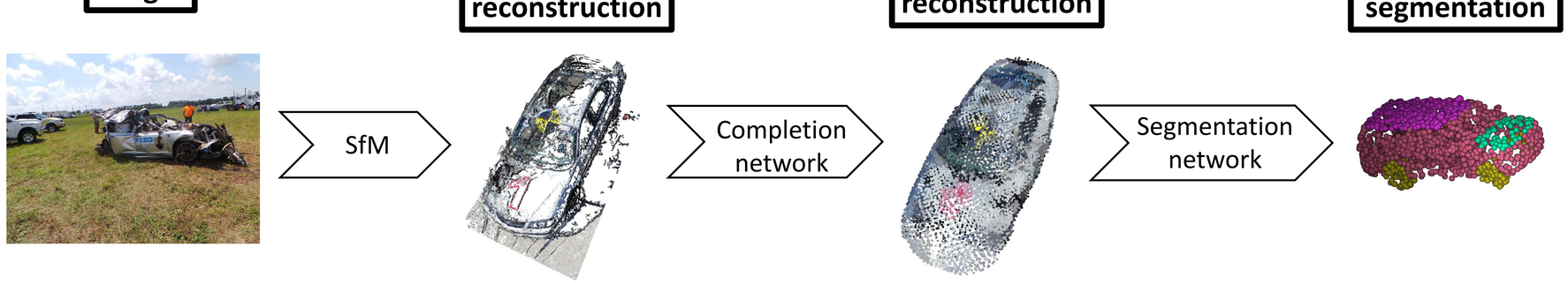
The Challenge

How to acquire a 3D model of an accident scene using only COTS cameras (e.g. smartphones) fully automatically?

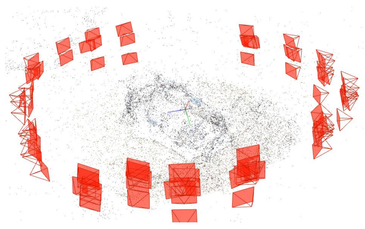


Proposed System

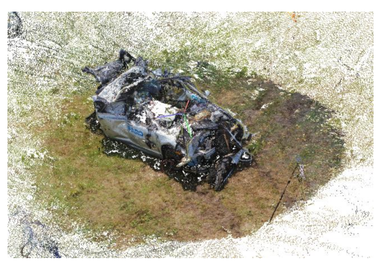


Structure from Motion

Input images:
About 100 images around the crashed car



Sparse reconstruction:
- Calculate strong feature points
- Match feature points
- Fit location of points and cameras



Dense reconstruction:
Use stereo techniques to get a dense point cloud

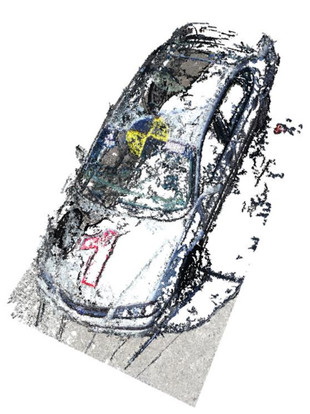
Solid model:
Use points and their normal to calculate a mesh surface

Towards Fully automatic analysis

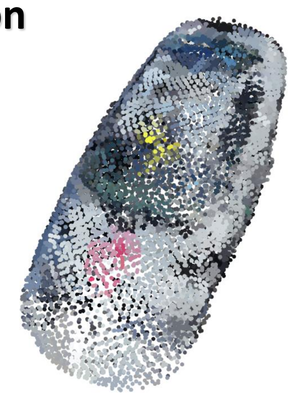
In order to automate the analysis of an accident scene, we need

- A complete 3D model of the vehicle involved (current work)
- A decomposition of the model into damaged/functioning parts (current work)
- A correspondence between the parts before/after accident (future work)
- A measure of deformation of the parts and the impact it received (future work)

Shape Completion

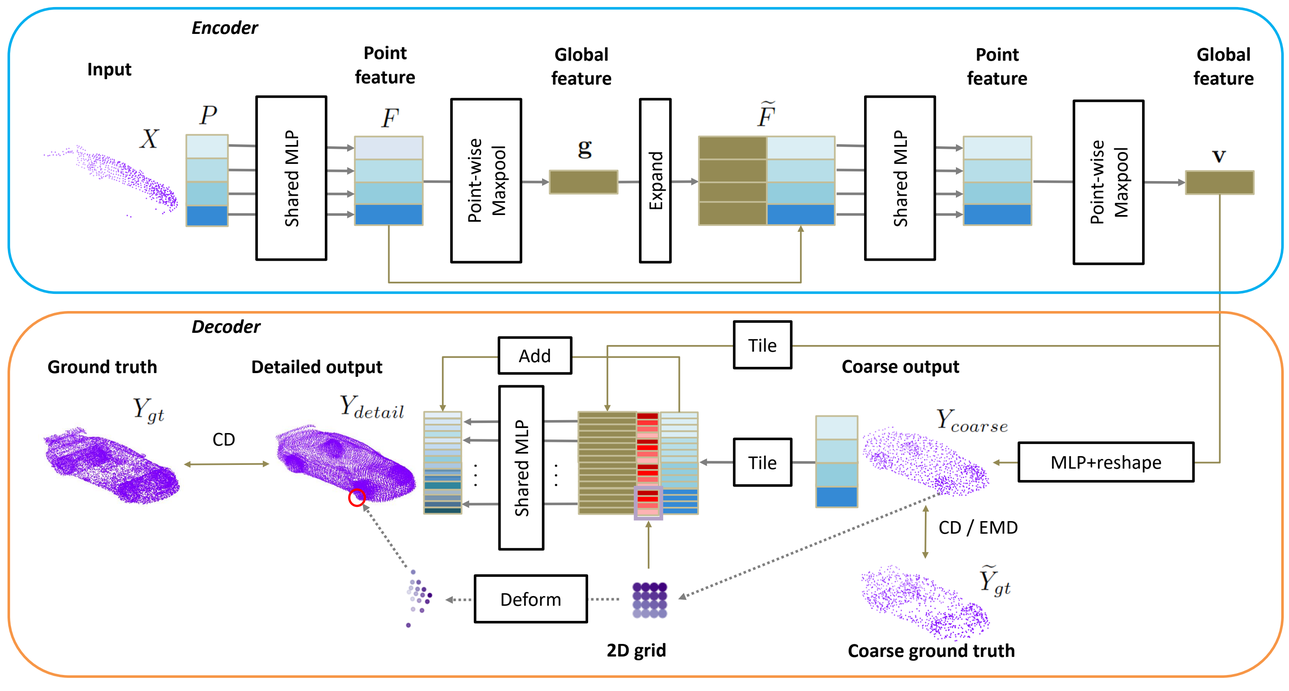


Input point cloud is a partial reconstruction from images taken at the accident's scene

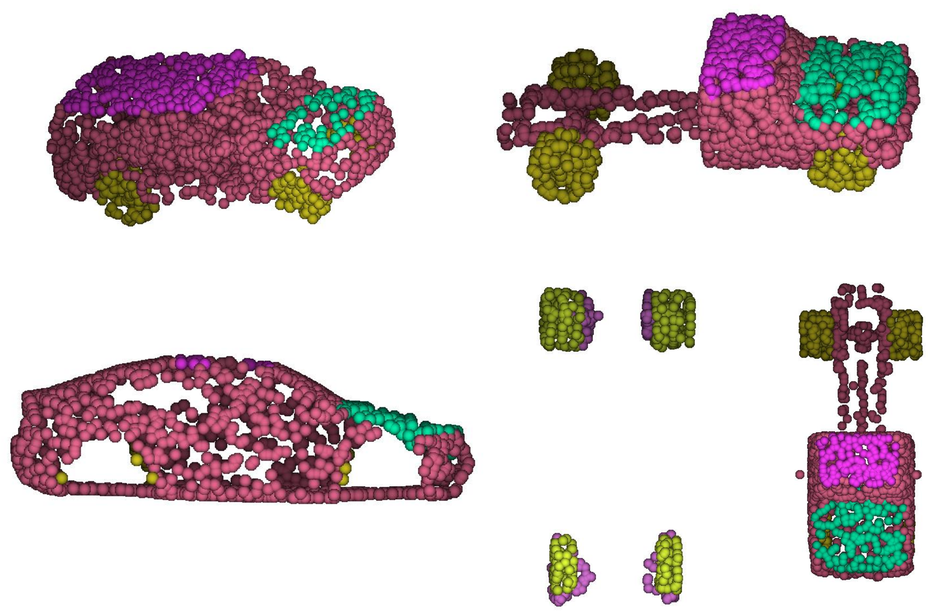


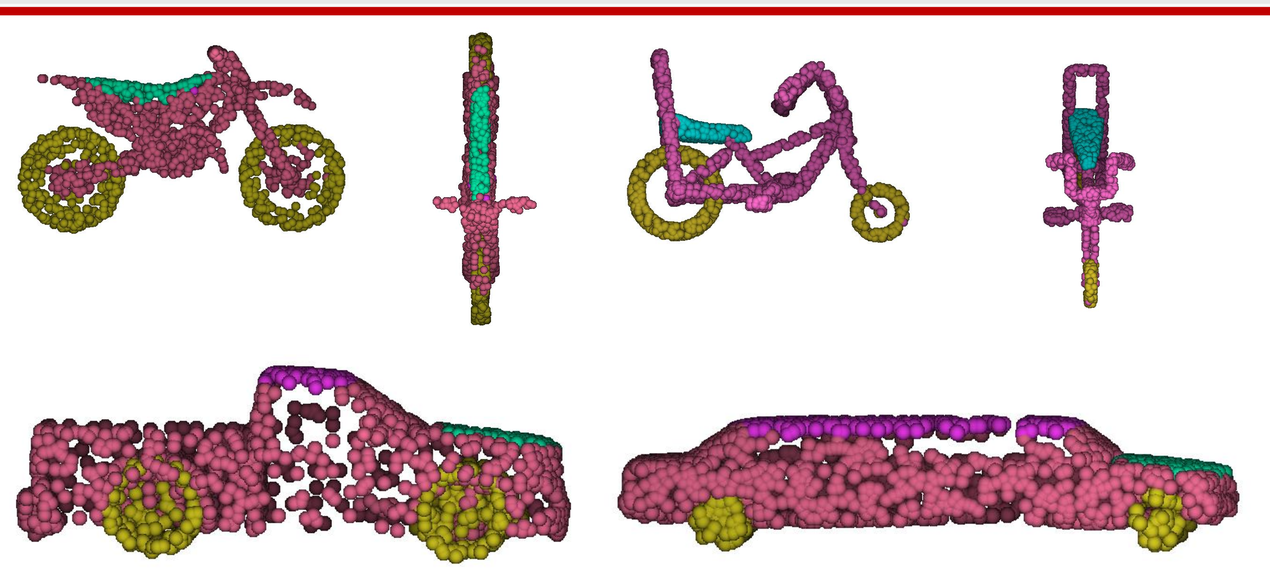
Output point cloud is a complete shape where holes and unobserved parts are filled

Completion Network Architecture



Part Segmentation





Acknowledgements

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References

[1] Schonberger, Johannes L., and Jan-Michael Frahm. "Structure-from-motion revisited." *Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition*. 2016.
[2] Yuan, Wentao, Khot, Tejas, Held, David, Mertz, Christoph, and Hebert, Martial. "PCN: Point Completion Network." *Proc. IEEE Conf. on 3D Vision (3DV)*. 2018.