VERIFICATION
VALIDATION
METHODS

PROJECT of the PEGASUS FAMILY

CONTEXT AWARE DATA REDUCTION FOR HIGHLY AUTOMATED DRIVING

How understanding the context of the Operational Domain can help decrease the space requirement for storing scenarios

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Motivation

Modern sensor packages of automated vehicles produce amounts of uncompressed data that can become too large to transmit, store and process. New approaches to data reduction are needed to mitigate the challenges arising with the advent of automated driving.

Approach

Context Aware Data Reduction is a novel method that aims to reduce the amount of data stored while attempting to preserve the relevant information of the data.

Step 1: Relevance based selection

This goal is achieved by dividing the data into a possibly relevant and an irrelevant subset, based on a pre-processed higher-level representation of the same data. By segmenting the data with this approach, data which contain information of no relevance, such as background objects and vegetation can be compressed.

Step 2: Irrelevant data compression

Compression is accomplished by transforming the original data into a representation that contains only certain aspects of the original data.

Step 3: Irrelevant data decompression

For later use, the compressed data is restored to the original, albeit synthetic, representation through a generative process.

Step 4: Merging

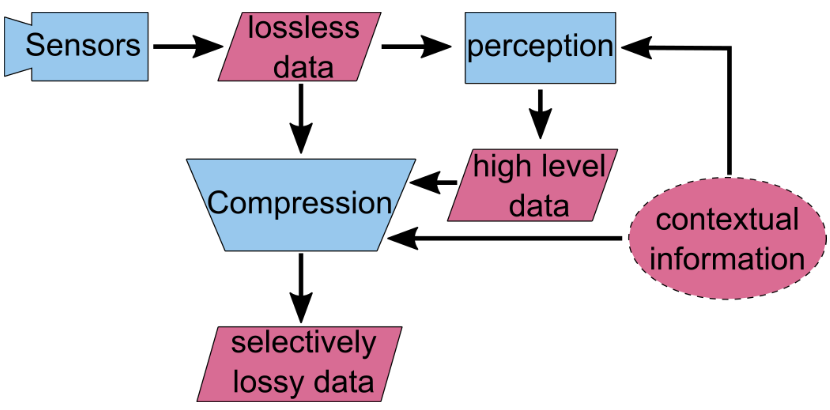
The uncompressed relevant information and the restored less relevant information are the merged, to form a singular environment representation again.

Guiding principle

Relevant information must be preserved as-is, irrelevant information can be stored as a plausible lie.

Principal Question

How can we distinguish irrelevant elements from relevant elements?



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Prototype

In a first prototype (Fig. 2 and Fig. 6), image data from driving scenarios, like the sample image in Fig. 3, are used. A semantic map is used for both as a higher level representation for the relevance based segmentation as well as the storage representation for the irrelevant data. The decompression process is realized by utilizing preexisting Generative Adversarial Networks for semantic image synthesis.

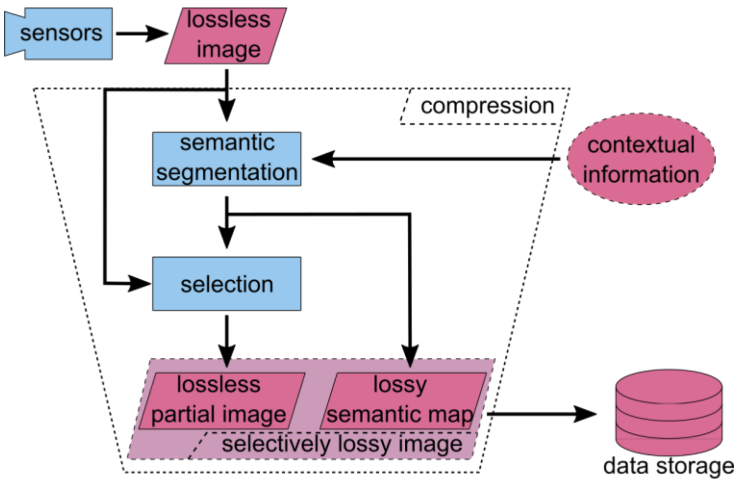

Fig. 2: Prototype Compression Process

Step 1: Relevance based selection

- Uses semantic map
- Based on object class
- Yields partial image (Fig. 4)

Fig. 3: Original Image

Step 2: irrelevant data compression

- Reuses semantic map from previous step
- Yields partial semantic map (Fig. 5)

Fig. 4: Partial Image

Further challenges:

- Substantiating the definition of (ir-)relevance for given use cases
- Adapt more complex model for (ir-)relevance

Fig. 5: Semantic Map

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Step 3: Irrelevant data decompression

- Based on NVidia Generative Adversarial Networks
- Synthesizes image from sematic map
- Yields synthetic partial image (Fig. 7)

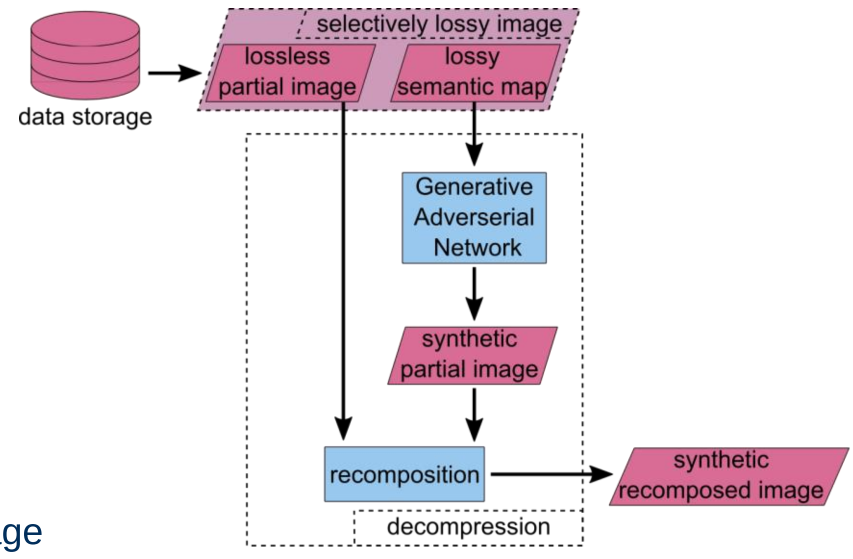

Fig. 6: Prototype Decompression Process

Step 4: Recomposition

- Yields synthetic recomposed image (Fig. 8)

Conclusion

Initial tests in the prototype phase have shown a data reduction of ~70% compared to the uncompressed data, with aggressive settings.

Fig. 7: Synthetic Partial Image

Outlook within VVM

- Online implementation of prototype
- Evaluation on diverse datasets
- Introduction of a resilient relevance model for identification of irrelevant elements

Fig. 8: Synthetic Recomposed Image