Operational traffic monitoring using very high resolution satellite imagery

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Motivation

► Reliable traffic statistics are needed for effective maintenance of roads and planning of new roads.

► Satellite imagery can provide supplementary information to the traditional ground-based sensors.

► Satellite monitoring provides excellent spatial coverage and makes it easier to obtain data for smaller and/or rural area roads where few or no ground-based measurements are performed today.
The above graphs show normal variation in traffic volume for small-town/countryside roads and totally for all vehicle size classes on weekly over a year (top) and hourly over a week (bottom) scale.
Operational system

► Our focus has been to develop a fully automated operational system for the estimation of the number of vehicles on a given road segment per hour (NVRH).

► The system includes separate modules for
  • road detection,
  • cloud and cloud shadow detection, and
  • vehicle detection.
SatTrafikk
processing chain

- satellite image
  - road vectors
    - road detection
      - geo-correction
        - localization (snake)
          - region growing
    - cloud/shadow detection
    - vegetation detection
  - vegetation mask
  - cloud mask
  - road mask
    - vehicle detection
      - segmentation
      - feature extraction
      - classification
    - vehicle counts
      - NVRH estimation
        - NVRH estimate
Road detection

Original road vector midline overlayed on multispectral image.

Final road mask overlayed on panchromatic image.
Cloud and cloud shadow detection
Vehicle detection

Vehicles in various sizes and shapes.
Vehicle detection

1. Rotate
2. Convolve with Laplacian of Gaussian filters
3. Estimate features
4. Reject weak candidates

Elliptical blob detection using Laplacian of Gaussian filters.
Vehicle detection results