Application of computer vision in roller operation management

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APAWV Annual Fall Meeting, 9/19/15

Objectives

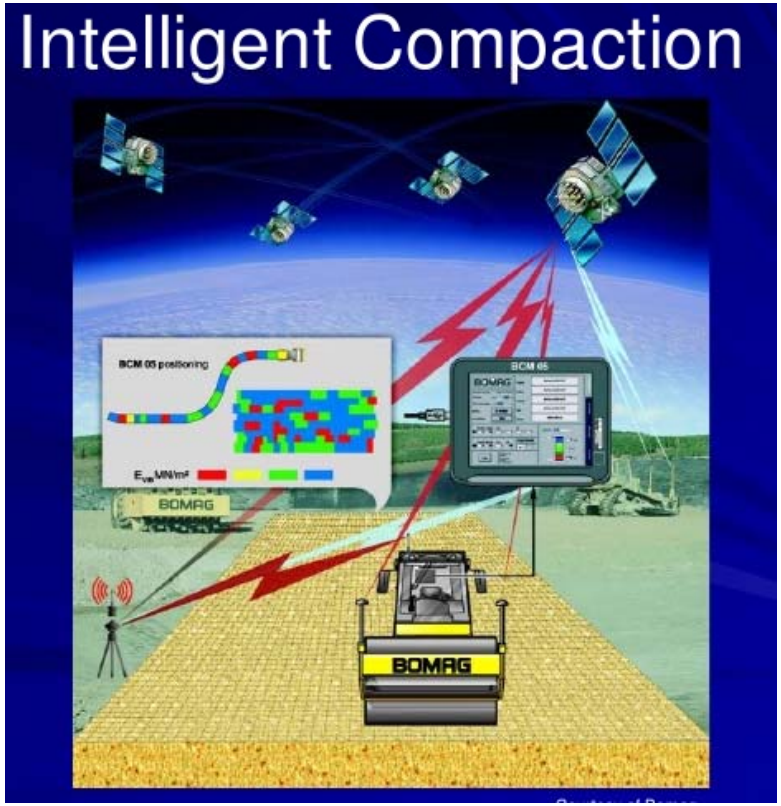
- The objective is to track and map roller path ECONOMICALLY
  - operator
  - QC/QA





Hasn’t this already been done?

- Yes….
- BUT



Hardware

FLIR PathFindIR

GoPro HERO3

Safety Vision DVR Model SVR 4100 and 7" Display Screen

Triple Suction Cup Camera Mount

Cost < $3000

The Image Solution

- Image is cheap compared to other sensing devices
- The technology is well developed and readily available
- Independent inference, unlike GPS it does not rely on an external source
- Provides additional information about site condition for further analysis

Going from images to results

- Calibration
- Homography
- Visual Odometery or Egomotion

Calibration

- Every camera or image sensing device has some degree of distortion
- The quality, price, and lens type can affect the distortion
- An image is a map of pixels, to make any measurement based on an image the pixels must be attached to coordinate system.
- The calibration process helps to remove the remove the distortions and also relate the image pixels with a coordinate system.

Homography

- Homography is the process of removing the perspective effect.
- In order to make any realistic measurement based on image, the perspective effect has to be removed.
- The transition to find the perpendicular view or the birds eye view which excludes the perspective effect is called is performed using homography.

Homography basically does this

Initial image

+ fancy math

Transformed image

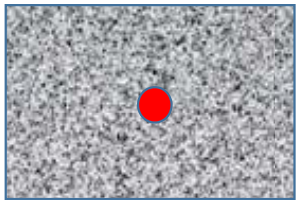
Visual Odometery

- Visual odometery is the process to track a moving object carrying an image sensing device.
- The process includes:
  - Feature extraction

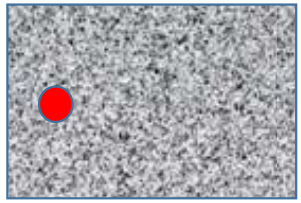
    The 1st step is to recognize fixed features in an image
  - Object Matching

    The features in successive frames will be matched
  - Trajectory

    The camera new location is back-calculated from the trajectory between the coordinates of the matched features in two successive image.



First image



Second image

Feature appears furthe
in image due to vehicle

Distance vehicle has moved between images

Concept applies to both lateral and longitudinal position

The “feature” can be pavement texture

Thermal infrared image

Due to the thermal difference between fresh asphalt and the surrounding environment the methodology works equally well during the day or night.

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Status

- Hardware works
- Software “alpha” testing
- Trials demonstrate
  - Ability to track roller
    - Longitudinal
    - Lateral
- Next
  - More data collection and analysis
  - Independent trials

- Implementation
  - DOH – supplement inspection
  - Industry -
    - training,
    - quality control,
    - roller management