# Inspection of railway infrastructure by image analysis

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# Overall scope

- Railway operations need to ensure
  - safety
  - reliability
- Railway infrastructure
  - is costly
  - is intended to last for a long time
  - must be maintained to provide functionality
- Manual track inspections
  - cause operational disturbances
  - are costly
  - may only be carried out say every second month
- Video based inspections
  - a possible aid?

# Inspection of railway infrastructure

- Track
  - surroundings (road crossings, vegetation, fences, etc)
  - rail
  - fastenings
  - sleepers
  - switches & crossings
  - ballast
  - groundwork (culverts, drainage, bridges, tunnels, etc)
  - ...
- Electricity
  - catenary (position, vibrations)
  - poles
  - S&C heating
  - ...
- Signalling
  - signalling lamps
  - signalling system
  - short-circuits
  - ...

# Examples – surroundings

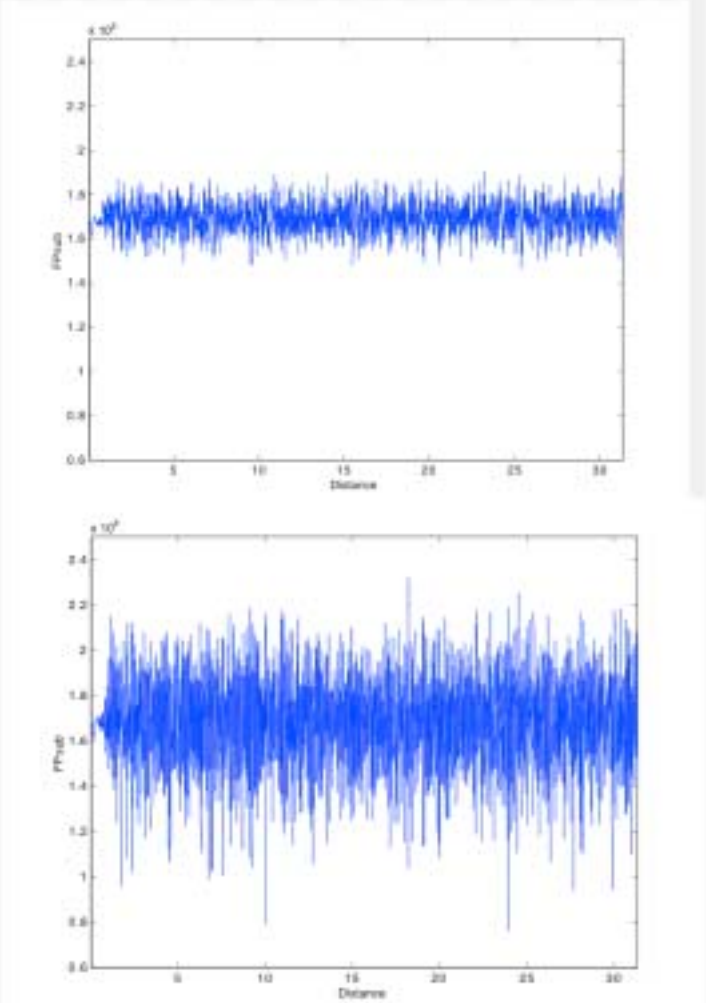
- free sight at crossings
  - planned cutting
- foreign objects in the track
  - sabotage
- trees close to catenary
  - risk of powercut
- vegetation in the track
  - need for spraying
- damaged animal fences
  - safety & economy

# Examples – catenary

- contact between catenary and collector is varying sideways
- too little deviation gives high wear
- too much deviation may give a "hook up"

# Examples – corrugation

- Corrugation leads to a wavy rail surface
  - this causes high vertical loads (and noise)
  - difficult to detect by normal force measurements due to high frequency
- Can image analysis (perhaps in combination with force measurements) be used to identify corrugation?

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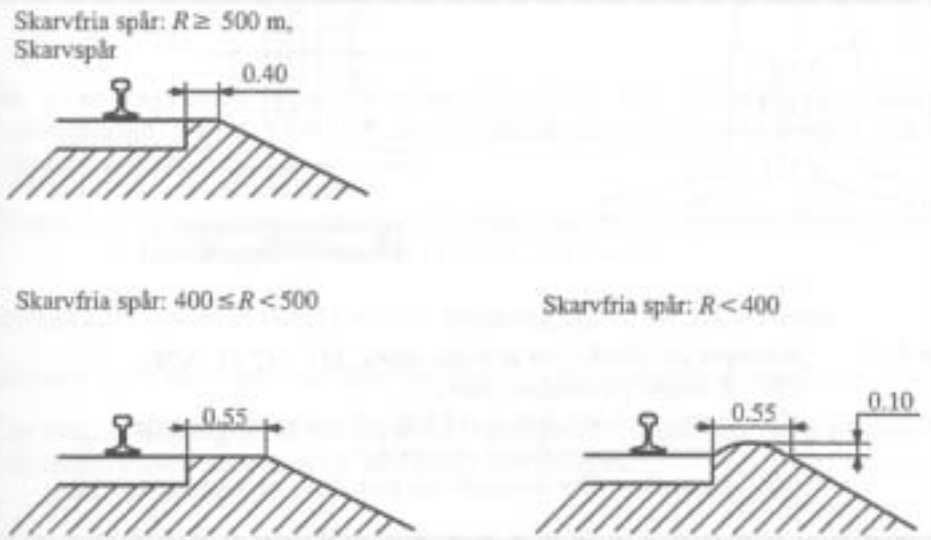
# Examples – ballast geometry

- Ballast provides support for the sleeper
  - a shoulder outside the sleeper to provide resistance against sun-kinks
  - no ballast over the sleeper top on high speed lines



# Examples – rail geometry

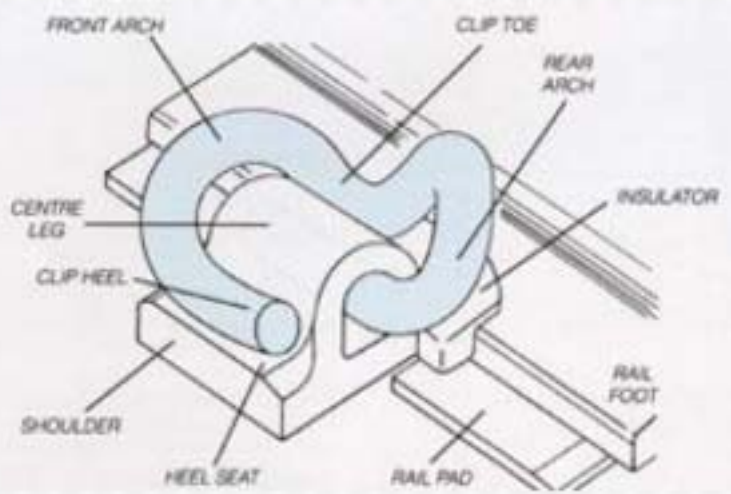
- Examples of causes
  - surface cracking of rails
  - wear of the rail
  - developing sun-kinks
  - misaligned tracks
- these are safety-related

# Example – rail joints

- On jointed tracks, the joints need to be maintained
  - too large a gap – high contact forces and risk for cracks
  - too close a gap – risk for lateral buckling of the track
- Can the size (and shape) of the gap be estimated by image analysis?

# Example – fastenings

- Fastenings attach the rail to the sleepers
  - missing fastenings may cause sun-kinks
  - may cause damage to the sleeper
  - loose sleepers may cause crushing of ballast (whitening)



# Image analysis – some challenges

- Inspection conditions
  - weather conditions (sun, rain, mist)
  - reflection of sunlight
  - dirt and mis-colouring of rail, ballast, etc
  - varying speed
  - window reflections
  - …
- Identification
  - position identification (km-poles & GPS)
  - classification (thresholds, degrees, uncertainties, etc)
  - quantification (to provide a database)

# Practical considerations

- Equipment
  - video-cameras
  - storage
  - processing
  - transmission
- Handling
  - must be "invisible" for train operator
- Interfaces
  - must co-operate with current software and databases
- A working image analysis would:
  - aid the track inspectors
  - improve standardization of inspections and classifications (e.g. degree of vegetation)
  - provide additional data to the track database