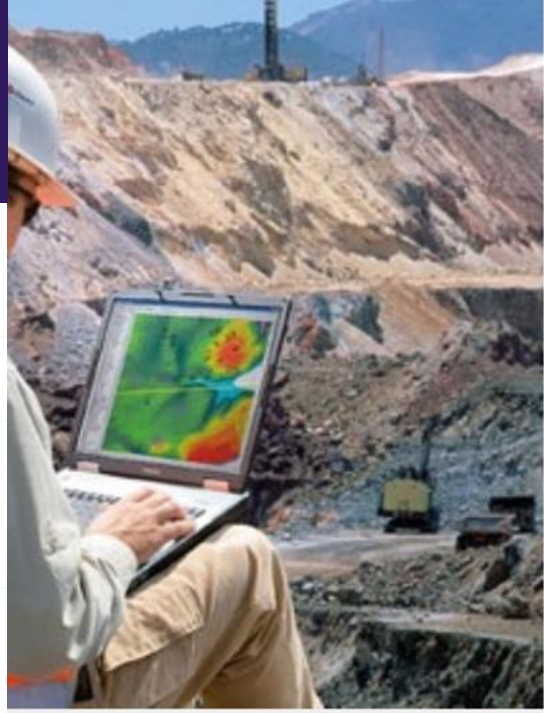
17 International Multidisciplinary Scientific GeoConference SGEM 2017

27 June - 6 July, 2017



Partial replacements of conveyor belt loop analysis with regard to its reliability

Mirosław Bajda

Ryszard Błażej

Leszek Jurdziak

SCIENCE AND TECHNOLOGIES IN GEOLOGY, EXPLORATION AND MINING

HR EXCELLENCE IN RESEARCH

DiagBelt Conveyor Belt Diagnostics

Politechnika Wrocławska

Presentation plan

- Damage identification problem: inspection v monitoring
- Research problem - how to fix the detected segment damage

1. New connection at fault site (short loop)
2. New small insert and 2 additional connections
3. **New, longer insertion and 2 additional connections**
4. **New, large insert to the shore with the replacement of the old connection**
5. Reliability of belt loops and reliability of a single section

- Non-linear belts wear rate

The problem of fault identification

The visual inspection is:

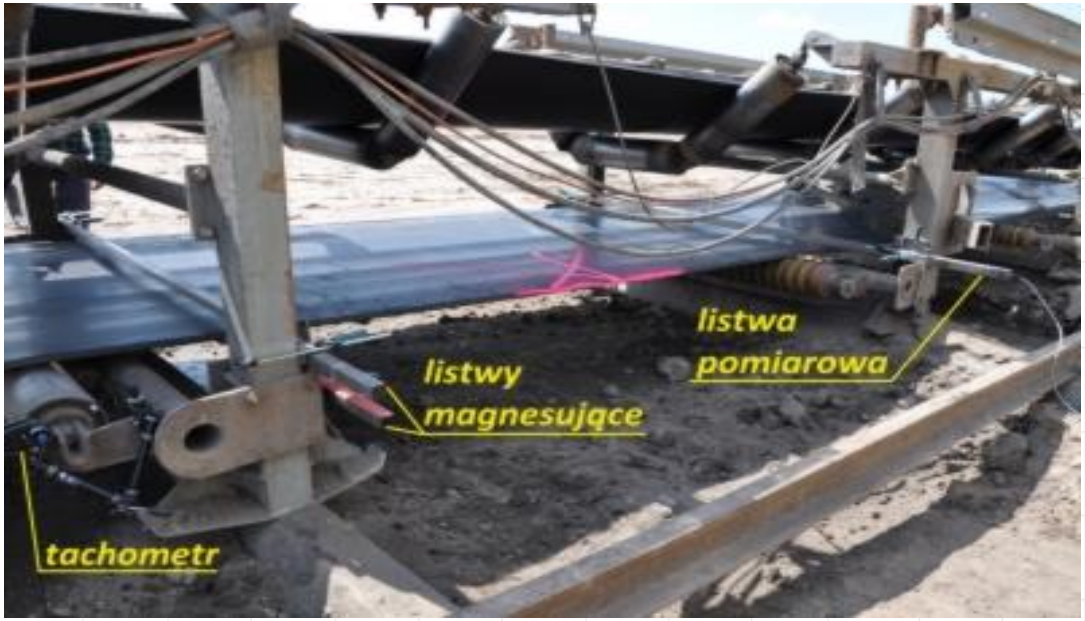
- subjective,
- not measurable and therefore inaccurate

No recording can not assess the damage and increase their changes over time

Assessment using diagnostic equipment:

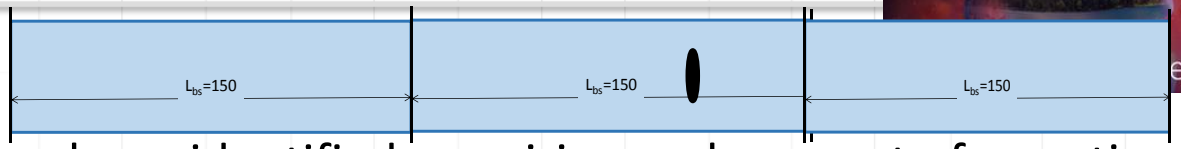
- Objective, precise and quantified,
- Accurate and reproducible,

Allows us to observe changes in belt state over time

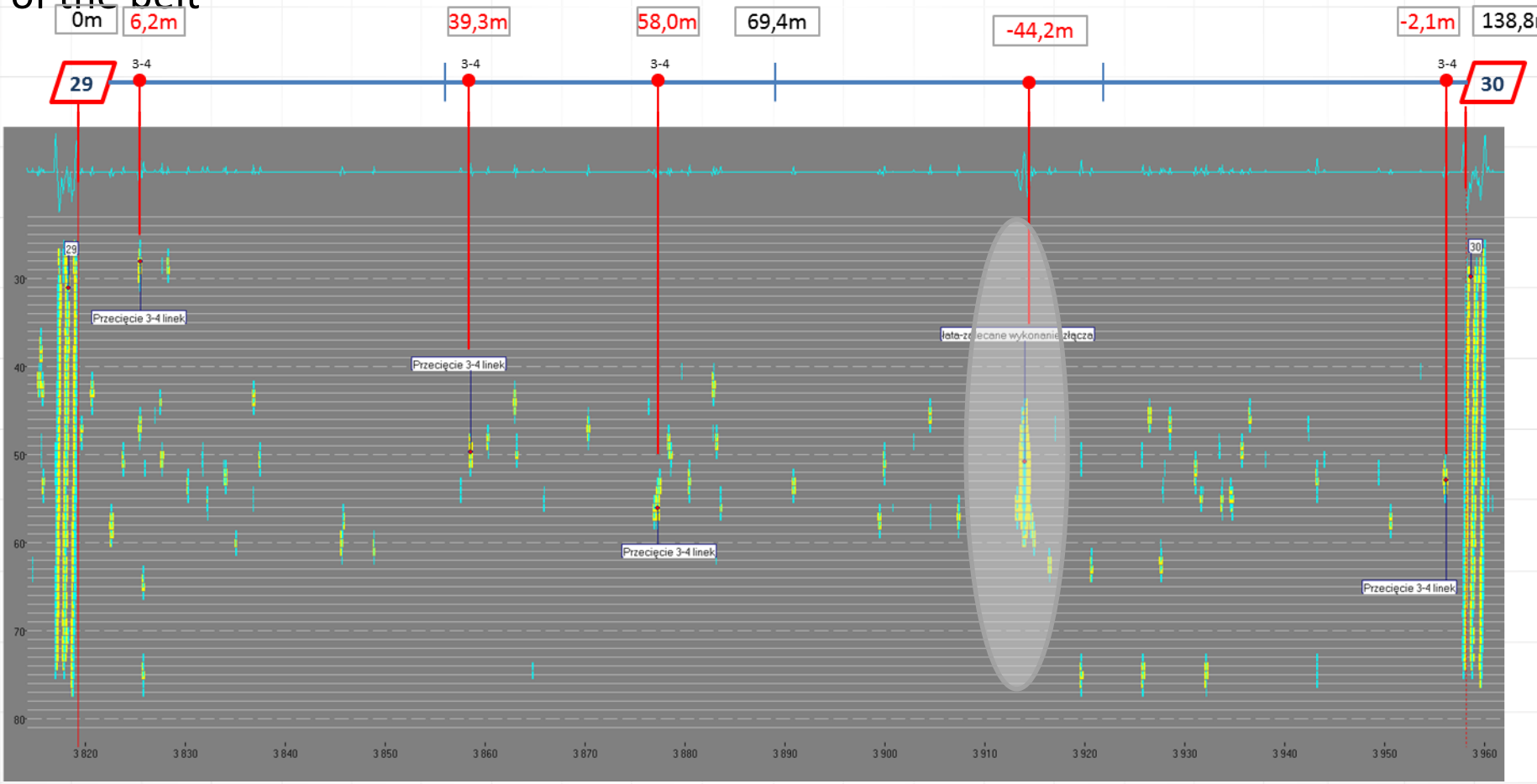


Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

The research problem



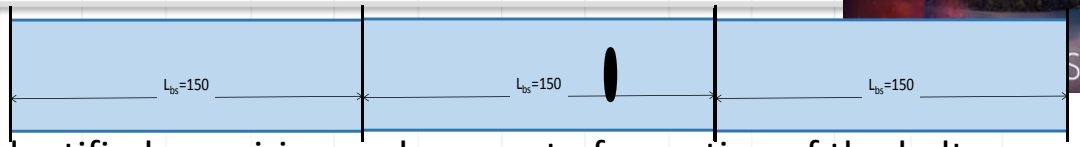
- Damage to the belt section has been identified, requiring replacement of a portion of the belt



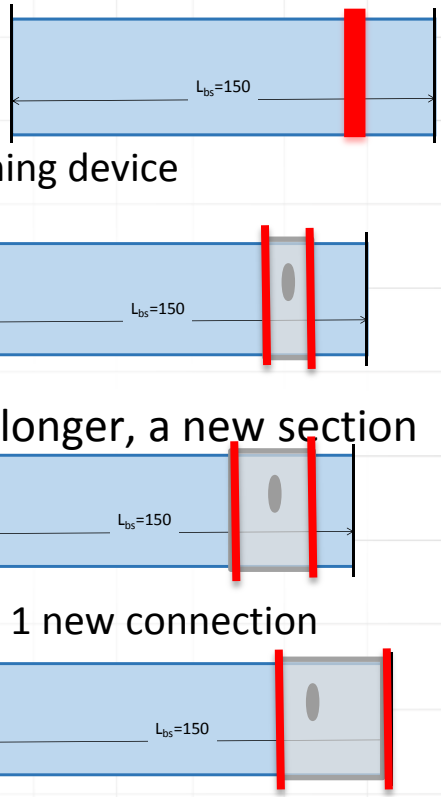
Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Politechnika Wrocławska

The research problem



- Damage to the belt section has been identified, requiring replacement of a portion of the belt
- The repair can be done by removing the damaged part and:
  1. performing in its place a new connection
     - Limitations: small size of damage and large stock of belt in the tensioning device
     - The result: a new, additional connection and shortened belts loop
  2. Inserting a new short segment into its place
     - Effect: new, small insert and 2 additional connections
  3. Removing adjacent, but unused portions and giving in their place longer, a new section
     - Effect: new, longer insertion and 2 additional connections
  4. The remainder of the belt section to the nearest conection
     - Effect: new, big insert with replacement of old connector for new and 1 new connection



- Corrective actions have consequences
  - Positive: **removed threat, increased reliability of repaired belt section**
  - Negative: **decrease of reliability of the segment after adding the connections - the weakest link in the belt loop !!!**

Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

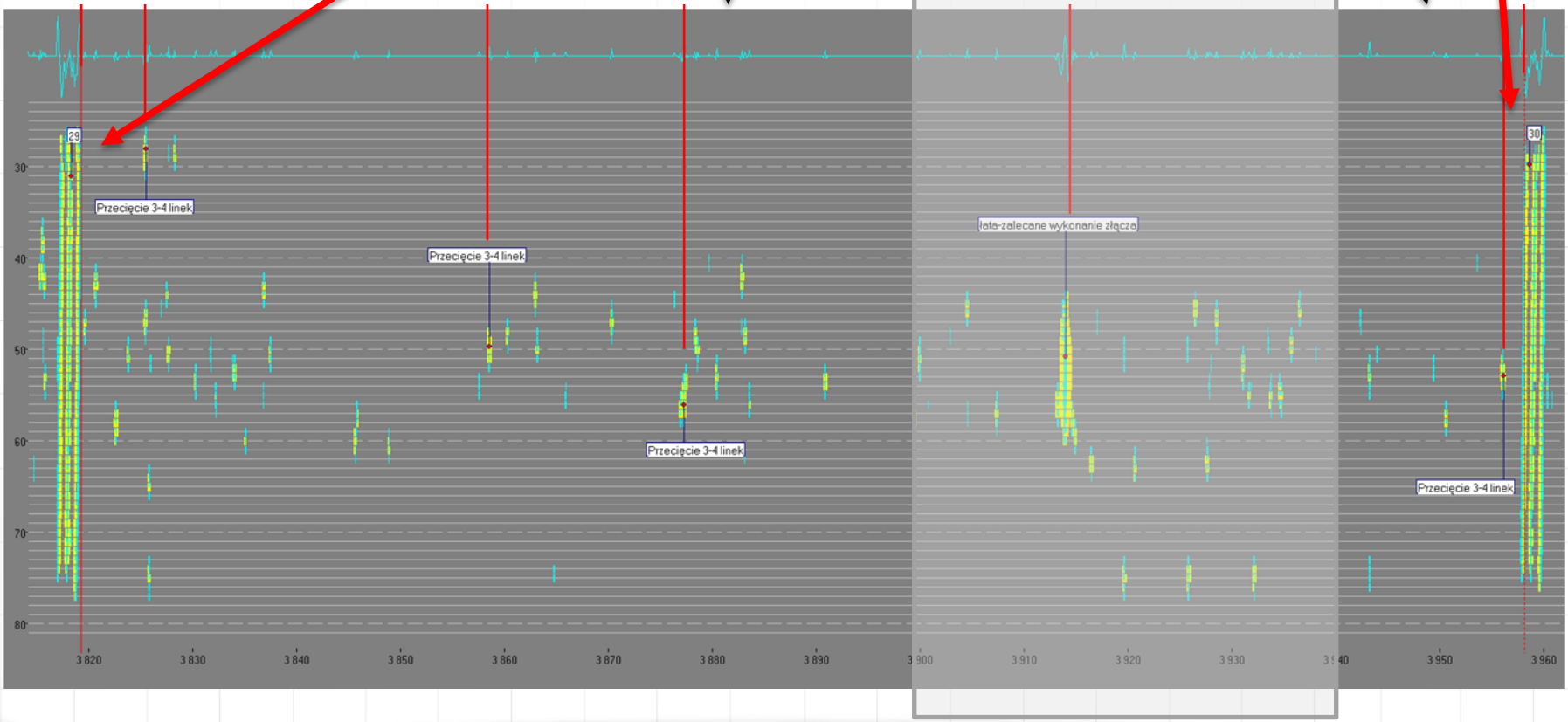
3. New, longer insertion and 2 additional connections

Reliability belt section

$$R_{nbs\_3}(t) = R_{oj}(t)R_{obLl}(t)R_{nj}(t)R_{nbLm}(t)R_{nj}(t)R_{obLr}(t)R_{oj}(t)$$

$L_{bl}+L_{bm}+L_{br}=L-L_j$, $2L_j<<L$

Insert 40m + 2 new splices



Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Politechnika Wrocławska

SGEM Scientific Scope

4. New, large insert to the edge with the replacement of the old connection

Reliability belt section

$$R_{nbs\_4}(t) = R_{oj}(t)R_{obLbo}(t)R_{nj}(t)R_{nbLbn}(t)R_{nj}(t)$$

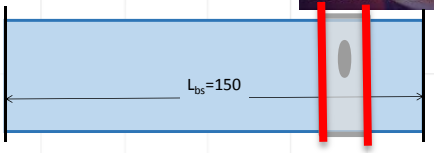
Insert 50m, elimination of 1 splice + 2 new splices

Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Politechnika Wrocławska

Reliability of loop loops and reliability of a single section

2. **Reliability of the insertion section in the middle**



$$R_{nbs\_2}(t) = R_{oj}(t)R_{obLl}(t)R_{nj}(t)R_{nbLm}(t)R_{nj}(t)R_{obLr}(t)R_{oj}(t)$$

$$L=L_l+L_j+L_m+L_j+L_r$$

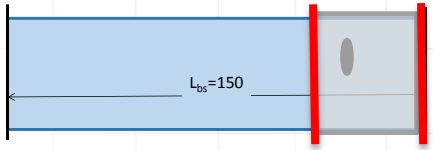
$$R_{nbs\_2}(t) = \frac{R^2_{nj}(t+T_0)R_{nbLl}(t+T_0)R_{nj}(t)R_{nbLm}(t)R_{nj}(t)R_{nbLr}(t+T_0)}{R^2_{nj}(T_0)R_{nbLl}(T_0)RnbLr(T_0)}$$

$$R_{nbs\_2}(t) = \frac{R^2_{nj}(t+T_0)R_{nbL-Lm}(t+T_0)R_{nj}(t)R_{nbLm}(t)R_{nj}(t)}{R^2_{nj}(T_0)R_{nbL-Lm}(T_0)}$$

Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Reliability of loop loops and reliability of a single section

4. **Reliability of the section with insert to the edge**



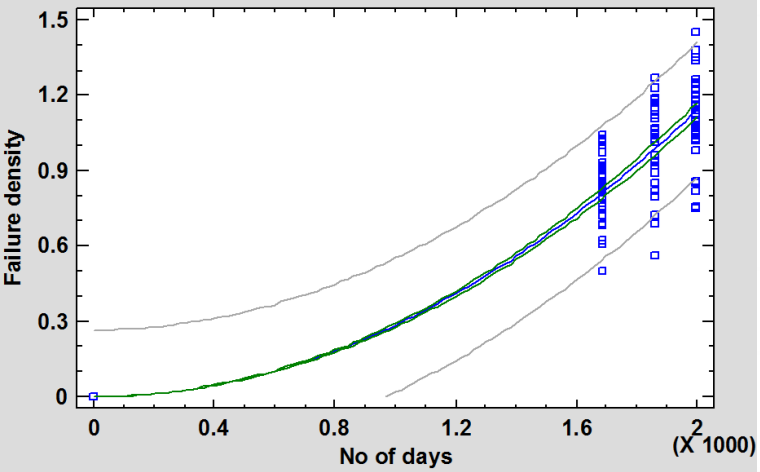
$$R_{nbs\_4}(t) = R_{oj}(t)R_{obLbo}(t)R_{nj}(t)R_{nbLbn}(t)R_{nj}(t)$$

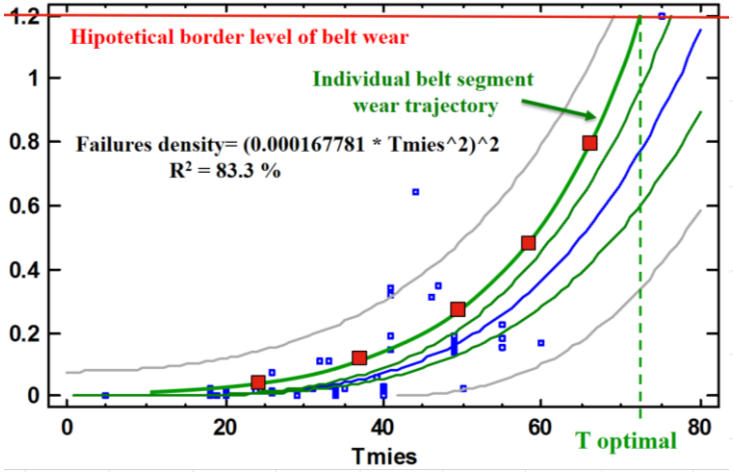
$$R_{nbs\_4}(t) = \frac{R_{nj}(t+T_0)R_{nbLo}(t+T_0)R_{nj}(t)R_{nbLn}(t)R_{nj}(t)}{R_{nj}(T_0)R_{nbo}(T_0)}$$

Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Non-linear belt wear rate

- We propose replacing the expected working time (calendar or effective) of the belts and connections for the expected time to reach the limit of damage density identified and verified during regular (cyclic or continuous) belt loop scanning.
- The remaining working time of the belts or joints can be corrected based on actual wear and tear - individual wear rate trajectories can be compiled on actual data and for a specific conveyor operating under specified conditions, which is more accurate than the remaining working time statistically determined for calendar time

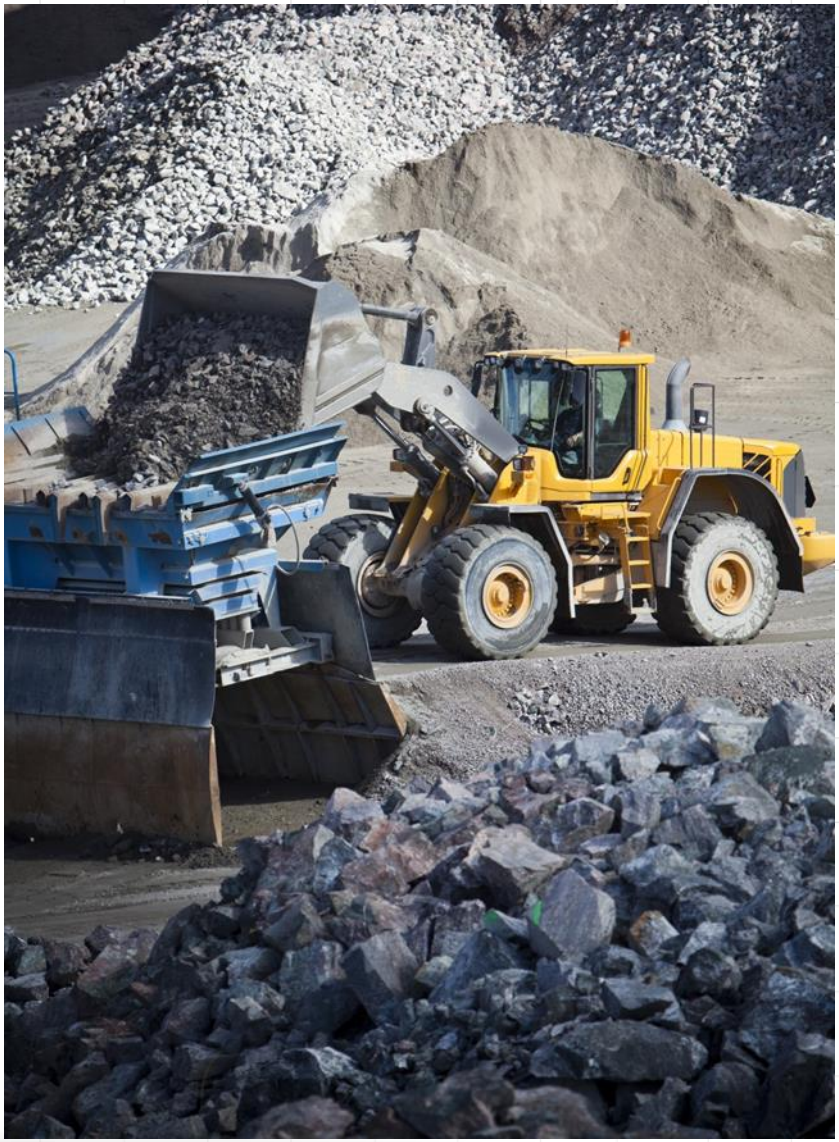




Mirosław Bajda, Ryszard Błażej, Leszek Jurdziak

Politechnika Wrocławska

Partial replacements of conveyor belt loop analysis with regard to its reliability



Narodowe Centrum Badań i Rozwoju

PBS Program Badań Stosowanych

NILOS POLSKA

Mirosław Bajda
Ryszard Błażej
Leszek Jurdziak

SZKOŁA GÓRNICTWA ODKRYWKOWEGO

HR EXCELLENCE IN RESEARCH

DiagBelt Conveyor Belt Diagnostics

Funding from NCBiR grant No. PBS3/A2/17/2015

Politechnika Wrocławska