Human-Feedback for AI in Industry

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AI-PROFICIENT
Artificial intelligence
for improved production efficiency,
quality and maintenance

This product is part of a project that has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No 957391.

Motivation

- AI actual demand in industry, continuous learning
- New approaches for continuous learning
  - Most industry not ready
- Traditional ML approach, isolated learning
  - Data requirements
    - Large
    - Quality
- Industrial usual scenario, in terms of data
  - Scarce
  - Unbalanced
- Necessary to think in an iterative ML approach
  - reinforcing the model in each iteration

Approach

- Human-feedback as an alternative for increasing
  - data quality
  - data quantity
  - new data
- Using new data incrementally for ML reinforcement
- Challenge: balance feedback gathering effort and ML reinforcement benefit

Human-Feedback AI in industry

- AI main challenges in industry
  - Previously mentioned data related issues
  - Human acceptance
- Human-feedback for AI reinforcement approach in AI-PROFICIENT:
  - Automatic quality data generation
  - Human-centred approach, by design
  - Reinforcing AI while ensuring human acceptance
  - Two main types: implicit and explicit feedback

Human-Feedback AI in industry - Implicit

- Implicit feedback: collected from an action, optionally done by a human, that has nothing to do with feedback.
- Requires human intention and contextual information for a correct data generation.
- AI-PROFICIENT approach
  - Monitoring system in production plants collecting real values and the context information (product type, timing, …)
  - Increasing specially data quality, by correcting potential biased or incorrectly annotated data
  - Different implicit-feedback strategies according to the different typologies of the AI-based models :
    - Predictive AI-based models
    - Recommendation (including optimization) AI-based models

Human-Feedback AI: in industry - Explicit

- Reinforcement learning without human intervention is not always feasible.

- Explicit human-feedback can overcome implicit feedback drawbacks (i.e. gathering reasons why a decision is taken increment contextual information)

- For different levels of digitalization in industry, different solutions. In AI-PROFICIENT,
  - Natural voice interaction
  - Augmented Reality based interfaces
  - (Extended) Shop-floor interfaces

Human-Feedback AI in industry – Lessons learned

- Industrial position: not change the working procedures and minimize new interfaces and devices in the workplaces for AI models and feedback mechanisms.

- In Ai-PROFICIENT, 6 industrial use cases with different needs

Feedback type	# use cases
Implicit Human-feedback	5
Explicit Human-feedback - Voice	4
Explicit Human-feedback - AR	1
Explicit Human-feedback - Shopfloor HMI	3

Human-Feedback AI in industry – Lessons learned

- Special care in ethics aspects, enhancing human acceptance
  - When generating human-feedback based data, indicate that the data is generated by human-feedback
  - For voice-based solutions
    - ethical best practices similar to the measures of Article 5(b) GDPR should be implemented
    - take into consideration the operator's mother tongue and if the former is not considered then, develop a clear, detailed, and practical plan for how the language gap and difficulties related to operator language and HMI use will be bridged.
  - The feedback mechanisms should not increase the user workload and if it does, strategies should be implemented to try to minimize it for ensuring adoption and acceptance.
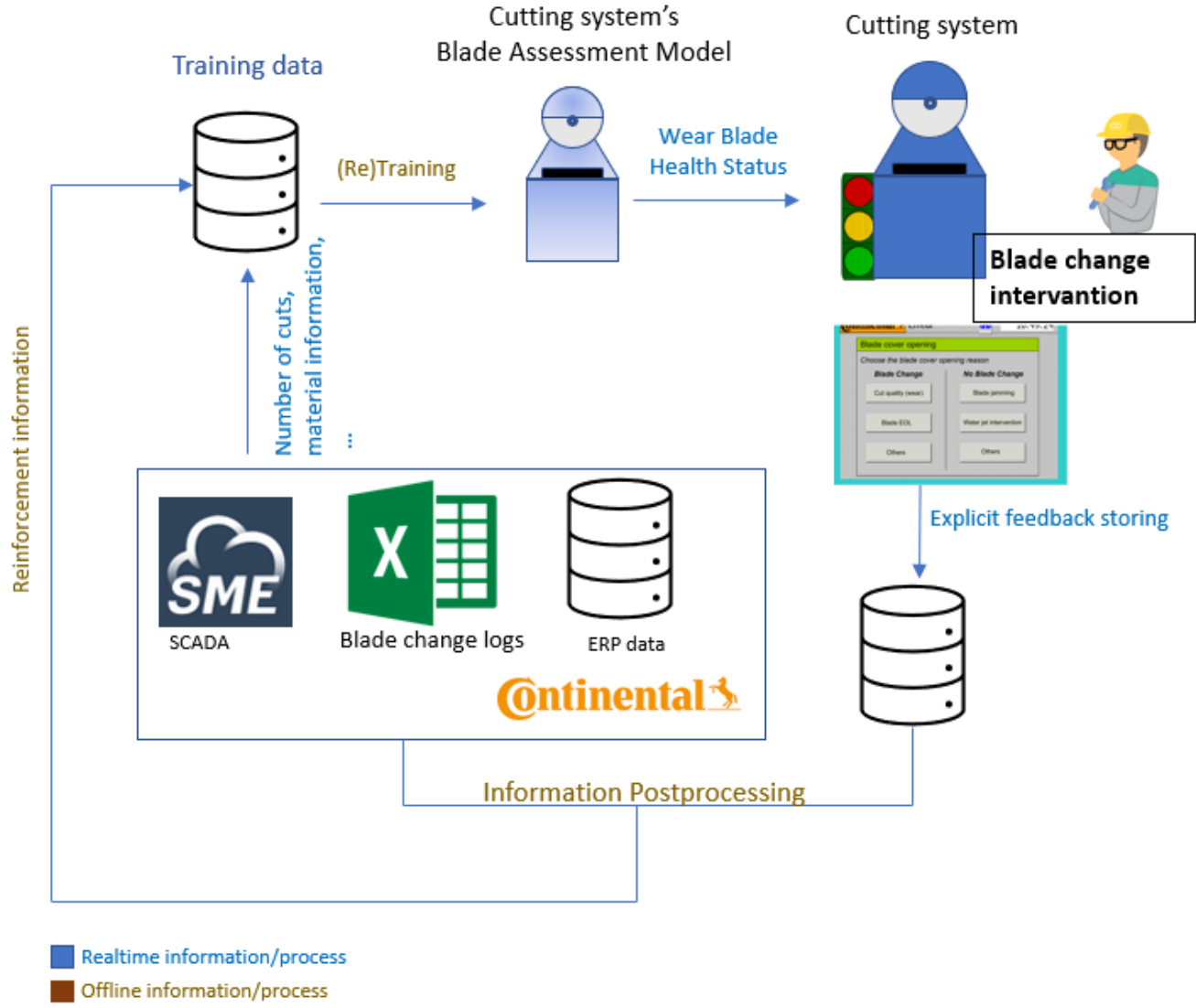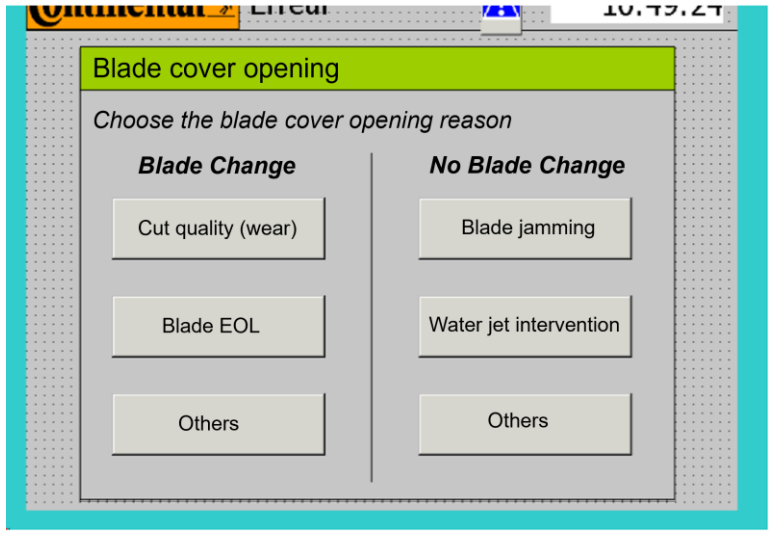
Human-Feedback AI in industry: in Continental

- Before AI-PROFICIENT
  - Blade-change
    - Break
    - Planned maintenance
  - No AI-model in place
  - Reports of blade-change at the end of the day in excel-sheet
  - No precise data

Human-Feedback AI in industry: in Continental

- During AI-PROFICIENT
  - First AI-based model trained with (unbalanced, small) historical data based on excel-sheets
  - Human-feedback in place
    - Implicit: monitoring system within trade-blade safety-cap a sensor
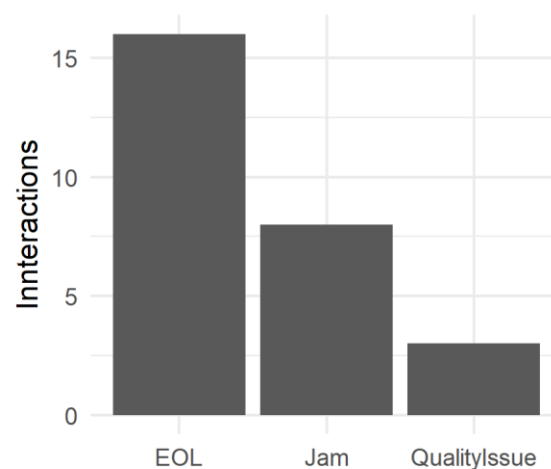   - Explicit: shopfloor interface for intervention reason gathering

Human-Feedback AI in industry: in Continental
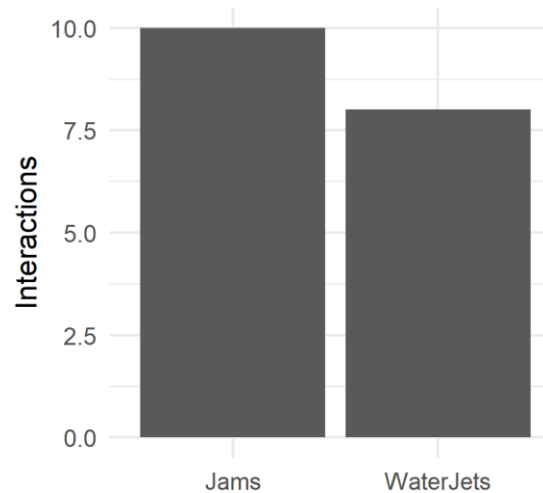
- AI-model reinforcement, based on

Recorded HMI interactions in period 2023-05-15 to 2023-10-02

Total interactions: 45

a) Blade replacement motivation annotations: 27

b) Through life annotations: 18

- *Rsquare* (model fiting) improvement from 0.9683 to 0.9880

Conclusions

- Data quantity & quality a challenge for AI in industrial scenarios

- Human-feedback gathering a good approach for dealing with it
  - while the foundations are laid in the industry to apply more advanced reinforcement techniques

- Necessary special focus on human empowerment
  - Ethical aspects to be considered
  - Minimal impact/change on workers procedures

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