Intelligent Open Test Bed for Materials Tribological Characterisation Services

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DT-NMBP07-2018, Open Innovation Test Beds for Characterisation

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Motivation

Industrial Motivation → Materials up-scaling
Reduction of time to market & reduction of costs
Overall Approach
Main Concept - Implementation

• 4 Interacting Units
  • Shared infrastructure
    • Enabling standardised tribological materials characterisation services

• IT-platform
  • Data driven services

• Collaboration interface
  • Virtual work rooms and lab-to-field upscaling tools

• Single-Entry Point
  • Service Provider
i-TRIBOMAT workflow & services

**industrial users & customers**

**new materials & product design**
- operational conditions: load, speed, temperature...
- tribological system & tribological mechanisms

**down-scaling**
- transferring operational conditions via modelling & simulation to laboratory for realistic tribo(logical)-testing
- selecting tribometers from the shared infrastructure
  - pin-on-disc, ball-on-disc, cylinder-on-roller, rubber wheel, thrust washer, ball-on-rod, block-on-ring, FZG-test, drag friction test, journal bearing test, sealing test stand, vacuum tests...
- designing experiments (DoE)
  - cost- and time-efficient testing matrix

**i-TRIBOMAT SEP**

**services**
- material characterisation
  - tribo-testing and triboanalytics
  - data-driven knowledge
  - data storage, sharing, analytics, artificial intelligence methods, ...

**up-scaling**
- transferring laboratory results to field application (lab-2-field)
- collaboration interface
  - virtual work rooms
  - numerical simulation
  - surrogate models, ...

**TRL 4 & 5**

TRL 5 → 6
As described above the overall workflow of i-TRIBOMAT goes through a modular system. The identified parts and their specific loading conditions are the input subsystems for the contact mechanics modelling and simulation. The system is divided into two main stages: MODA: DOWN-SCALING and MODA: UP-SCALING. These stages are connected to LABORATORY characterisation services, which include material characterisation, tribo-testing, and triboanalytics.

**SYSTEM/COMPONENT**
- new material and/or product design
- operational conditions load, speed, temperature...
- tribological system & tribological mechanisms

**LABORATORY**
- characterisation services
- material characterisation
- tribo-testing and triboanalytics

Figure 2: MODA linked to the workflow of i-TRIBOMAT
Idea- Combined Ontologies

**i-Tribomat:** represent the material not only as itself but as the evolution of it (properties, etc.) after a process.

**VARM** is an ontology from the manufacturing domain. **EMMO** is an ontology from the materials domain.

<table>
<thead>
<tr>
<th>Class</th>
<th>Description</th>
<th>Data properties</th>
</tr>
</thead>
</table>
| MaterialClass          | Represents a grouping of material definitions with similar characteristics.                   | • materialClassID [max-1]  
                      |                                                                             | • description  
                      |                                                                             | • model         |
| MaterialDefinition     | Represents a material.                                                                     | • materialID [max-1]  
                      |                                                                             | • description  
                      |                                                                             | • model         
                      |                                                                             | • maker         |
| MaterialSegmentSpec    | Represents the material resources required for a process segment.                           | • description  
                      |                                                                             | • quantityString|
                      |                                                                             | • dataType      |
Idea: Guided data uploading methodology

Experimental data in testbed projects will be **uploaded in a similar manner**: Users will combine data generated from commercial or custom software **from different sources with manual annotations**.

**How:** Data from the raw files will be extracted to pre-defined data model entities and complemented with the manual inputs

**Manual data inputs:**
- **Graphical user interfaces:** Ease the data uploading with simple and clear interfaces. Checks to ensure all inputs are filled correctly.

**Automatic data processing:**
- **Data verification:** Check that provided data is well formatted
- **Data validation:** Check that the provided data is good in context
- **Data extraction:** Parse and transform the data to own model entities.
## Project contribution to CHADA template

<table>
<thead>
<tr>
<th>i-TRIBOMAT</th>
<th>DT-NMBP07-2018</th>
<th><a href="http://www.i-tribomat.eu">www.i-tribomat.eu</a></th>
<th><a href="mailto:i-tribomat@ac2t.at">i-tribomat@ac2t.at</a></th>
</tr>
</thead>
</table>

### List of main characterisation methods used in the project

<table>
<thead>
<tr>
<th>Method</th>
<th>Level of use in the project</th>
<th>Main reference in the project</th>
<th>Contact email(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin on Disc (basic tribological test)</td>
<td>Advanced user</td>
<td>AC2T LTU VTT BAM TEKNIKER</td>
<td><a href="mailto:ivana.toth@ac2t.at">ivana.toth@ac2t.at</a> <a href="mailto:ichiro.minami@ltu.se">ichiro.minami@ltu.se</a> <a href="mailto:Helena.Ronkainen@vtt.fi">Helena.Ronkainen@vtt.fi</a> <a href="mailto:dirk.spaltmann@bam.de">dirk.spaltmann@bam.de</a> <a href="mailto:Alberto.alberdi@tekniker.es">Alberto.alberdi@tekniker.es</a></td>
</tr>
<tr>
<td>Twin disc (rolling/sliding tribological test)</td>
<td>Method developer</td>
<td>TEKNIKER</td>
<td><a href="mailto:Alberto.alberdi@tekniker.es">Alberto.alberdi@tekniker.es</a></td>
</tr>
<tr>
<td>FZG (gear tribological test)</td>
<td>Advanced user</td>
<td>TEKNIKER</td>
<td><a href="mailto:Alberto.alberdi@tekniker.es">Alberto.alberdi@tekniker.es</a></td>
</tr>
<tr>
<td>TESSA (seals tribological test)</td>
<td>Instrument developer</td>
<td>TEKNIKER</td>
<td><a href="mailto:Alberto.alberdi@tekniker.es">Alberto.alberdi@tekniker.es</a></td>
</tr>
</tbody>
</table>
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