Auto Procedure Parsing: A Natural Language Processing Approach

August 2022

Jinding Xing
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Idaho National Laboratory
Idaho Falls, Idaho 83415

http://www.inl.gov

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THE PRACTICAL PROBLEM

• Nuclear Power Plant (NPP) operating procedure is “a set of rules that describes how actions on the plant should be made if a certain system goal should be accomplished”[1].

• U.S. NPPs use paper-based procedures (PBPs).

• Common errors with PBPs are: following the wrong procedure, omit a step etc. [2].

MOTIVATION

• Computer based procedures (CPBs) offer great improvement in ensuring plant safety.

• Some studies rely on experienced operators to understand the procedure content and then reorganize the procedure with digitally executable capabilities [3]. Other studies utilize the procedure format to design rules to extract information from the operating procedures.

• Existing studies in procedure parsing are manual, laborious and extract limited information.

This study aims to automatically extract critical information from operating procedures for generating computer interpretable representation of procedures. Such representation can further be used for automatic dynamic human reliability analysis and CPB design etc.

METHODOLOGY

Procedure Label Taxonomy

- Component
  - Type: Name
  - State
  - Aggregation
- Action
  - Type: Name
- Process variable
  - Name
  - Range
  - Unit
- Reference
  - Name
  - Type

Data Preparation

Use “BIO” tagging format and INCEpTION platform for procedure labeling

NLP Model Architecture

RESULTS

Model Training and Testing

Scenario: Startup procedure (20 operation steps)

<table>
<thead>
<tr>
<th>Precision</th>
<th>Recall</th>
<th>F1 Score</th>
<th>Accuracy</th>
</tr>
</thead>
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<tr>
<td>0.554</td>
<td>0.566</td>
<td>0.542</td>
<td>0.802</td>
</tr>
</tbody>
</table>

Computer Interpretable Representation of Procedures

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