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Auto Procedure Parsing: A Natural Language Processing Approach

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Auto Procedure Parsing: A Natural Language Processing Approach

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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].

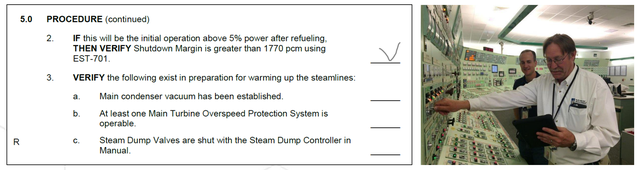

Fig 1. An example of paper-based procedure (left) and computer-based procedure process (right) [3].

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

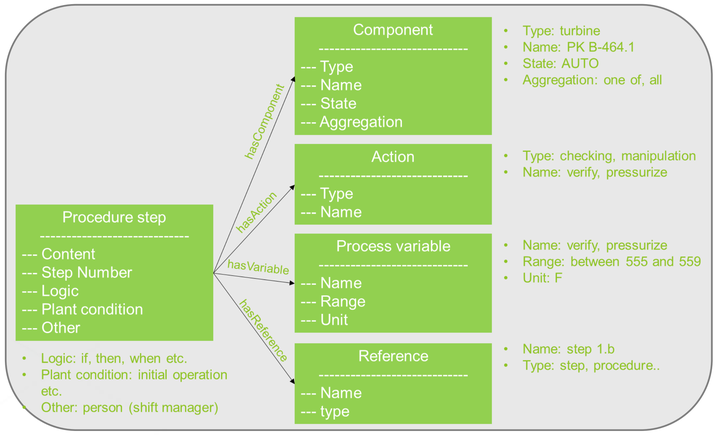

Fig 2. A taxonomy for operating procedure labeling. This taxonomy aims to extract information regarding plant component, operation action, process variable, and reference from the operation procedure.

Data Preparation

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

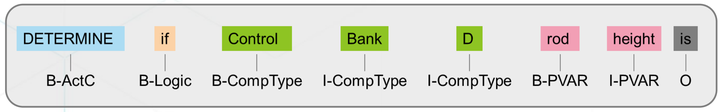

Fig 3. Example of “BIO” tagging format. B-beginning, I-inside, O-outside.

NLP Model Architecture

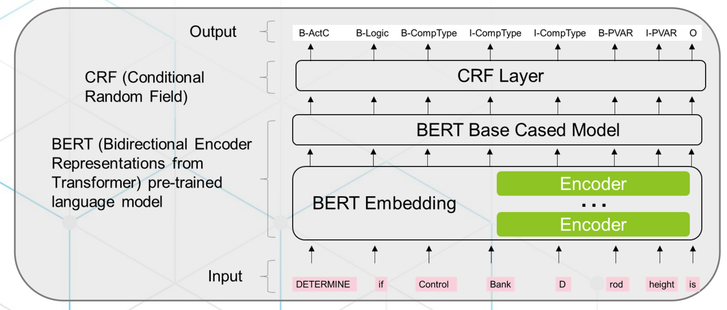

Fig 4. The architecture of the proposed BERT-CRF model

RESULTS

Model Training and Testing

Scenario: Startup procedure (20 operation steps)

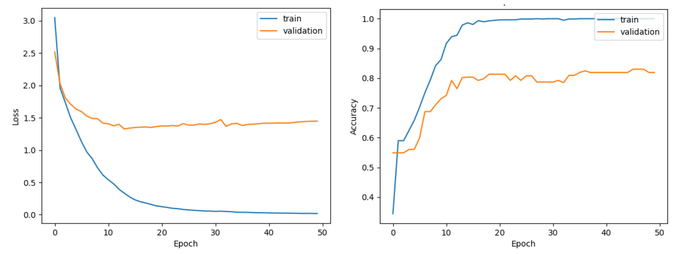

Fig 5. Training results trained on 50 epochs: loss (left), accuracy (right)

	Precision	Recall	F1 Score	Accuracy
Testing	0.554	0.566	0.542	0.802

Computer Interpretable Representation of Procedures

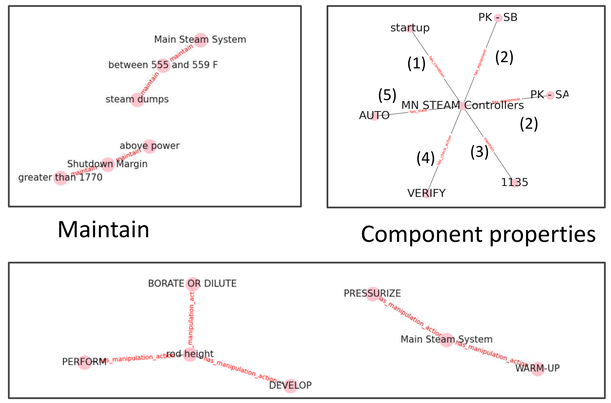

Fig 6. Computer interpretable representation of the startup operation generated from the extracted information. Component properties: (1) has_condition, (2) has_equipment, (3) maintain, (4) has_check_action, (5) has_state.

ACKNOWLEDGMENT

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