LINGUISTIC ANALYSIS OF ENGINEERING REQUIREMENTS

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- Grammar rules
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Background

• Figure shows a “bad” requirement being changed to a “good” requirement

• A formalized syntax to describe what a good requirement looks like

• A process to transform bad requirements into good requirements

The printer must print 35 ppm

Printer must print faster than previous model

Improve quality, make it better than previous model
Background

☐ The correctness of a requirement is difficult to define.
  ▪ Ambiguity, Syntax, Solution Neutrality, Semantics

☐ Currently correctness is a subjective measure.
  ▪ What if it can become an objective measure?

☐ Before correctness can become an objective measure requirements need to be formalized.
Grammar Rules

- Transitive Verbs
- Intransitive Verbs
- Linking Verbs
Transitive Verbs – verbs that always have a noun that receives the action of the verb

Example: Dr. Mocko rides his bike

Requirement Example:

The seat must prevent injury
Grammar Rules

- Intransitive Verbs – verbs that never has a direct or indirect object, but it can be followed by an adverb or adverbial phrase.

  - Example: *Dr. Summers falls.*

  - Requirement Example: *The airplane seat must float.*
Grammar Rules

- Linking verb – verb that connects the subject of a sentence to a noun or adjective that renames or describes it.

  Example: *Dr. Fadel is a professor.*

  Requirement Example:
  
  *The seat must be easy to adjust.*
How do these grammar rules apply to engineering requirements

- Transitive and intransitive verbs relate to functional requirements
  
  **Action verbs = function**

- Linking verbs relate to form requirements
  
  **Linking verbs = state of being**
In addition to the type of requirement, verb types along with the subject and object can determine whether a requirement is solution neutral or not.

Example: *The engine must accelerate the vehicle.*

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Subject       Verb       Direct Object
The vehicle   must       accelerate
Subject       Verb
The vehicle   must       tow a boat
Subject       Verb       Direct Object
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Linguistic Rules for Engineering Requirements

- All functional requirements should be expressed as either transitive or intransitive verb sentences.
- All form requirements should be expressed as a linking verb with an adjective as the subject compliment not a noun.
- In a functional requirement the subject should be the system of interest.
- In a transitive verb sentence the direct object should never be the system or any part of the system.
- In an intransitive verb sentence the adverbial phrase (constraint) should not contain any part of the system or the system itself.
Process for checking requirements

1. Requirement Sentence
   - Is the main verb transitive? (Yes/No)
     - Yes: Refine requirement
     - No: Is the main verb intransitive? (Yes/No)
       - Yes: Is the main verb linking? (Yes/No)
         - Yes: Refine requirement
         - No: Form Requirement
       - No: Is the direct object part of the system? (Yes/No)
         - Yes: Does the adverbial phrase reference any parts of the system? (Yes/No)
           - Yes: Refine requirement
           - No: Adj.
         - No: Functional Solution Neutral Requirement
     - No: Form Requirement

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Tool for Processing Requirements

Input and Verification

- Requirement Input
- Requirement Refinement Process
- Error Identification

Database

Queries

Query

- Report

Input and Verification

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Future Work

- Include a limited vocabulary
- Parse more requirements to ensure rules are valid
- Create a database