Using Drools rule-platform for the optical CAD web application development

Maxim Kolchin, Dmitry Mouromtsev

National Research University of Information Technologies, Mechanics and Optics
Introduction: the goal

Automation of optical structural synthesis

*Structural synthesis* is the key-step in the whole optical design process.
Introduction: the structural synthesis

*Structural synthesis* - the procedure of choosing the types, quantities and mutual arrangement of optical elements

\[ Y1A1P + C1P2P + B2A2P + T2A3P + C3F3F \]
Introduction: existing approaches

- various catalogues (patents, technical literature etc),
- genetic algorithms,
- own experience,
- expert system - *this is our way*. 
Introduction: our approach

Our approach based on rule-based design method of structural synthesis was proposed by M. Russinov and developed by I. Livshits.

\[
great \text{ experience in optical design} + expert \text{ system technology} = \text{ automated structural synthesis}
\]
Implementation: selection of a rule-platform

Requirements:
- advanced knowledge representation language,
- the support of traditional programming languages,
- the forward chaining,
- tools for knowledge engineering,
- open-source license and an active community.

Rule-platforms: OpenRules, OpenL Tablets, Drools, CLIPS
Implementation: overview of the system architecture

Here:
- Repository - Drools Guvnor,
- Web application - the server developed by us,
- Inference engine - Drools Expert.
Implementation: algorithm of the inference

- Technical requirements
  - Classification rules
    - The classification
      - The elements selection rules
        - Optical elements
          - The schemes generation rules
            - Structural schemes

- a fact (POJO)
- the inference engine
- a package of production rules
Implementation: an example of the rules

The elements selection rule (using DSL language and Drools Guvnor):

```
WHEN
1. The system was classified with
2. - D equal to 1
3. - S equal to 2

THEN
1. Insert an element B1P1A
/show
```

The same rule in DRL (Drools Rule Language):
```
rule "B1P1A"
when
    Classification(d==1, s==2)
then
    insert( ElementFactory.newElement( "B1P1A" ));
end
```
Implementation:
a screenshot of the UI

Technical requirements
- aperture speed: 1.8
- angular field: 84
- focal length: 4.5 mm
- back focal distance: 2 mm
- image quality: GEOMETRIC
- entrance pupil position: FORWARD
- spectral range: 450 to 650 nm

The lens classification...
- of optical characteristics: J - 1 W - 2 F - 0
- by purposes: L - 2 Q - 0
- according to design features: S - 0 D - 2
- The complexity of the lens: R - 7

Schematic circuits

<table>
<thead>
<tr>
<th>#</th>
<th>Schema</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Y101P + B2A3P + T3F3O</td>
</tr>
<tr>
<td>1</td>
<td>Y101P + B2A3P + T3F3l</td>
</tr>
<tr>
<td>2</td>
<td>Y1A1P + B2A3P + T3F3D</td>
</tr>
<tr>
<td>3</td>
<td>Y1A1P + B2A3P + T3F3l</td>
</tr>
<tr>
<td>4</td>
<td>Y1P1P + B2A3P + T3F3O</td>
</tr>
<tr>
<td>5</td>
<td>Y1P1P + B2A3P + T3F3l</td>
</tr>
</tbody>
</table>
Conclusion:

- Developed notations for optical elements and structural schemes,
- Implemented a prototype of the system based on the rule-based design method of structural synthesis.
Q & A