MODELLING AND OPTIMIZATION OF DATA-DRIVEN SCENE GRAPHS

CAOR ROBOTICS LAB
MINES ParisTech

S. BOISGÉRAULT, E. VECCHIÉ
Sebastien.Boisgerault@mines-paristech.fr

EDONA/HMI
SYSTEMATIC

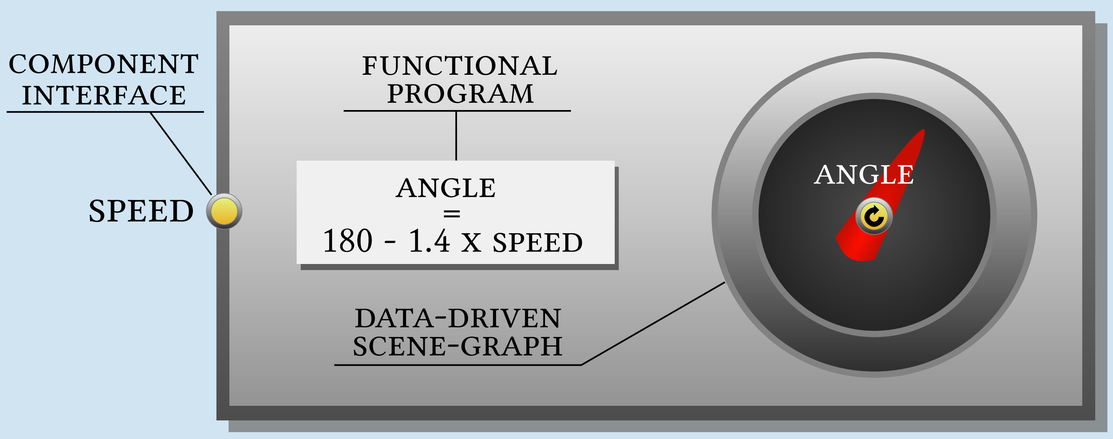
AUTOMOTIVE USER INTERFACES

Information Displays Design

- Our main target: reconfigurable instrument clusters,
- Primary issue: safety-critical software component,
- Secondary issue: rendering performance.

USER INTERFACE MODEL

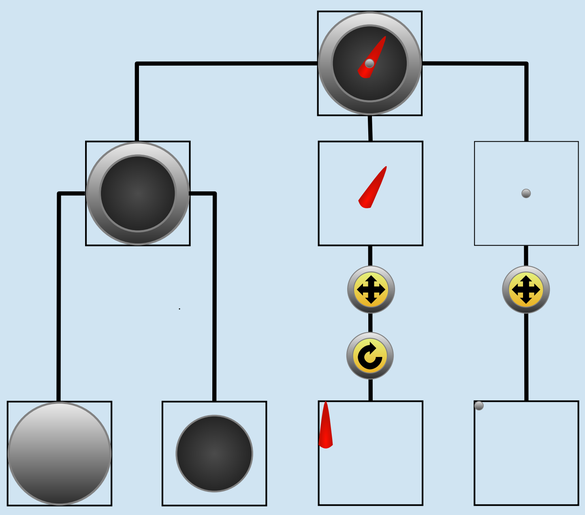
Component Model



- The functional model is a synchronous data-flow program : given interface inputs, it updates the graphics data, the component output values and the functional state.
- This programming model has clear semantics and is amenable to extensive formal verification and analysis.

GRAPHICS MODEL

Data-driven Scene Graph



Characteristics:

- Static tree structure and fixed set of typed nodes,
- Vector and raster graphic primitives,
- Mutable node attributes,
- Format: extension of SVG, Scalable Vector Graphics.

GRAMMARS AND SEMANTICS

EDONA/HMI

$$\mathbf{group}(\text{opacity} \leftarrow 1.0, \text{rotate} \leftarrow 0.0)$$
$$\langle\, \mathbf{text}(\cdots), \mathbf{image}(\cdots), \mathbf{line}(\cdots) \,\rangle$$

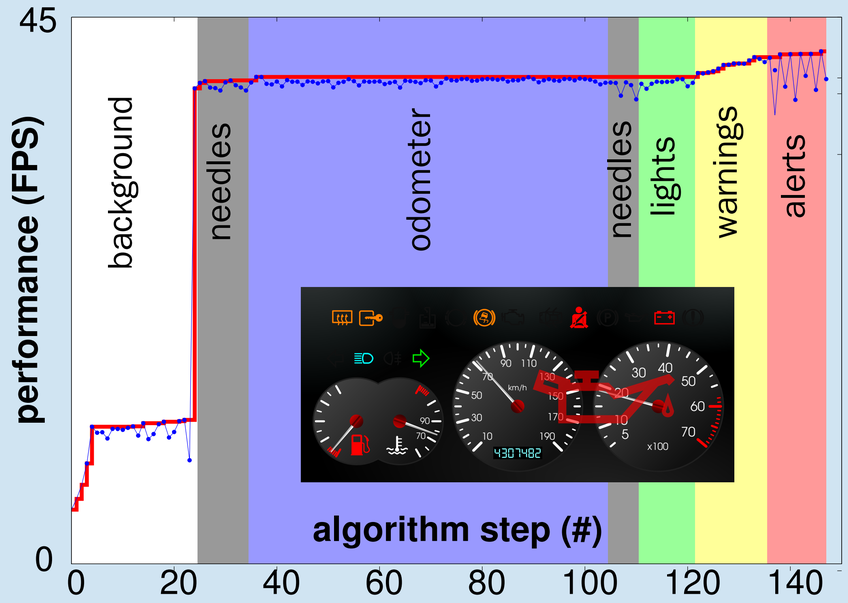
$\mathbf{text}(\text{data} \leftarrow \text{“EDONA/HMI”},$
$\text{font} \leftarrow \text{“Libertine”},$
$\text{font-size} \leftarrow 72,$
$\text{translate} \leftarrow (30, 0))$

$\mathbf{image}(\text{data} \leftarrow \text{“file:direction.png”},$
$\text{width} \leftarrow 75,\ \text{height} \leftarrow 75,$
$\text{translate} \leftarrow (250, 0))$

$\mathbf{line}(x_1 \leftarrow 0,\ y_1 \leftarrow 100,$
$x_2 \leftarrow 900,\ y_2 \leftarrow 100,$
$\text{stroke} \leftarrow \text{rgb}(0, 0, 0),$
$\text{stroke-width} \leftarrow 5)$

- We define three grammars to describe formally data-driven scene graphs, display lists and images.
- A set of transformation rules provide precise semantics for data-driven scene graphs.
- Optimizations may take place among equivalent models.

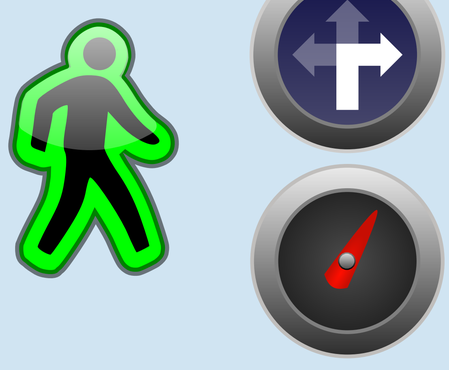
RENDERING OPTIMIZATION



- We optimize the model against a given graphics renderer, for a reference inputs data set.
- Our algorithm selects among immutable vector fragments, the ones to be replaced by raster graphics.

CONCLUSIONS

LOVe project



- A complete U.I. meta-model was designed for safety.
- It is suitable for model-level graphics optimization.
- This design framework was successfully applied to intelligent transportation systems prototypes.