TU/e technische universiteit eindhoven

LaQuSo Laboratory for Quality Software

A hierarchy of SOS rule formats

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History of the *tyft/tyxt* format

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Frits Vaandrager: "write an introduction into ACP$_\varepsilon$".

$$a \xrightarrow{a} \tau \qquad \tau \xrightarrow{\tau} \tau \qquad \varepsilon \xrightarrow{\surd} \delta$$

$$\frac{p \xrightarrow{a} p'}{p+q \xrightarrow{a} p'} \qquad \frac{q \xrightarrow{a} q'}{p+q \xrightarrow{a} q'}$$

$$\frac{p \xrightarrow{a} p'}{p \cdot q \xrightarrow{a} p' \cdot q} \qquad \frac{p \xrightarrow{\surd} p' \quad q \xrightarrow{a} q'}{p \cdot q \xrightarrow{a} q'}$$

$$\frac{Body_X \xrightarrow{a} p'}{X \xrightarrow{a} p'}$$

$$\frac{p \xrightarrow{\tau} p' \quad p' \xrightarrow{a} p''}{p \xrightarrow{a} p''} \qquad \frac{p \xrightarrow{\tau} p' \quad p' \xrightarrow{a} p''}{p \xrightarrow{a} p''}$$

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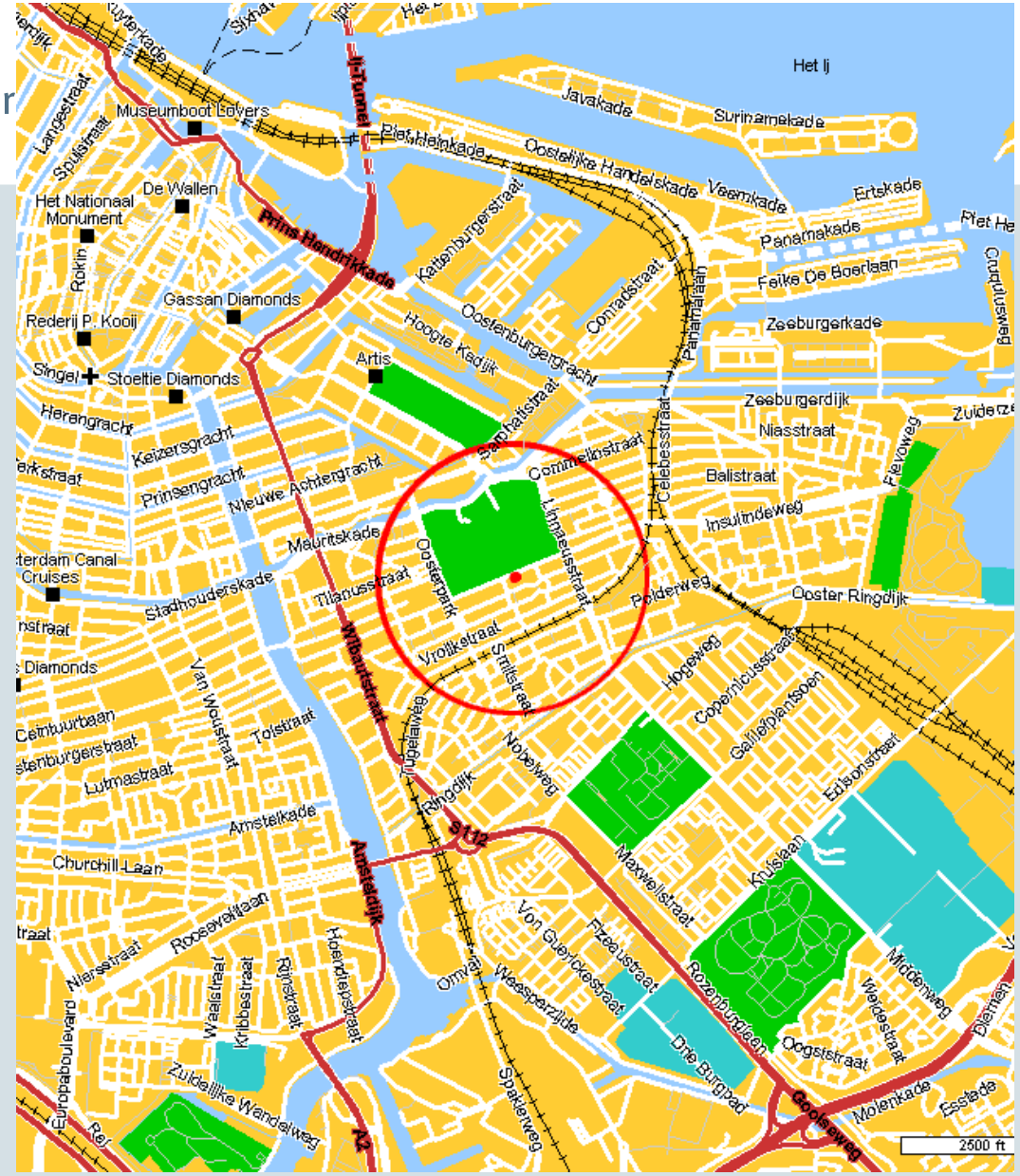
Structured operational semantics

$$\frac{Body_X \xrightarrow{a} p'}{X \xrightarrow{a} p'}$$

$$X \xrightarrow{\tau} Body_X$$

tyft/tyxt-format



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Negative premises (priority operator)

$$\frac{p \xrightarrow{a} p' \qquad \forall b{>}a \;\; p \not\xrightarrow{b}}{\theta(p) \xrightarrow{a} \theta(p')}$$

ntyft/ntyxt-format
De-Simone-format
Bloom-Istrail-Meyer-format (*BIM*-format)

Developments from 1990-2004

- Predicates
- Terms as labels
- Formats linked to a particular semantics
- Variable binding and substitution
- Structural congruences
- Formats for process/data pairs
- Rules with orderings
- .....

Predicates (BV 93, Verhoef 95)

$$\varepsilon\downarrow$$

$$\frac{P_0\downarrow \quad P_1\downarrow}{P_0;P_1\downarrow}$$

$$\frac{P_0 \xrightarrow{a} P_0'}{P_0;P_1 \xrightarrow{a} P_0';P_1}$$

$$\frac{P_0\downarrow \quad P_1 \xrightarrow{a} P_1'}{P_0;P_1 \xrightarrow{a} P_1'}$$

Terms as labels (Bernstein 98, others)

$$\frac{x \xrightarrow{[w/a]} y}{m?a.x \xrightarrow{m?w} y} \quad [prefix1]$$

$$\frac{x \xrightarrow{m!} y_1 \qquad x \xrightarrow{m!^*} y_2 \qquad x' \xrightarrow{m?y_1} y'}{x \mid x' \xrightarrow{\tau} y' \mid y_2} \quad [par2]$$

Variable binding/substitution

- Fokkink/Verhoef98

$$send(x,y.v^*) \xrightarrow{(x,y)} v^*$$

$$\frac{y^*[w^*/x] \xrightarrow{a} z^*}{y^* \xrightarrow{b} z^*}$$

Structural congruences [MR05]

$$\frac{P_0 \xrightarrow{a} P_0'}{P_0||P_1 \xrightarrow{a} P_0'||P_1'}$$

$$P_0||P_1 \equiv P_1||P_0$$

$$!P \equiv P||!P$$

Ordering on rules [Ulidowski & Phillips97]

$$\frac{P_0 \xrightarrow{a} P_0'}{P_0;P_1 \xrightarrow{a} P_0';P_1} \quad > \quad \frac{P_1 \xrightarrow{a} P_1'}{P_0;P_1 \xrightarrow{a} P_1'}$$

Name passing/scoping (ZMP05)

$$\frac{\nabla x(Px \xrightarrow[p]{A} Qx)}{\nu x.Px \xrightarrow[p]{A} \nu x.Qx} \quad \text{(RES)}$$

$$\frac{P \xrightarrow[n \to p]{\downarrow x} M \qquad Q \xrightarrow[v \to p]{\uparrow x} N}{P \mid Q \xrightarrow[p]{\tau} \nu y.(My \mid Ny)} \quad \text{(CLOSE)}$$

Transition systems with data (MRG04)

$$\frac{\{\langle t_{pi}, t_{di}\rangle \xrightarrow{l_i} \langle t'_{pi}, t'_{di}\rangle \mid i \in I\}}{\langle t_p, t_d\rangle \xrightarrow{l} \langle t'_p, t'_d\rangle}$$

$$\frac{\{\langle t_{pi}, t_{di}\rangle \xrightarrow{l_i} \langle y_{pi}, t'_{di}\rangle \mid i \in I\}}{\langle f_p(x_{p0},\ldots,x_{pn-1}), t_d\rangle \xrightarrow{l} \langle t'_p, t'_d\rangle}$$ process-*tyft*

General

Specific

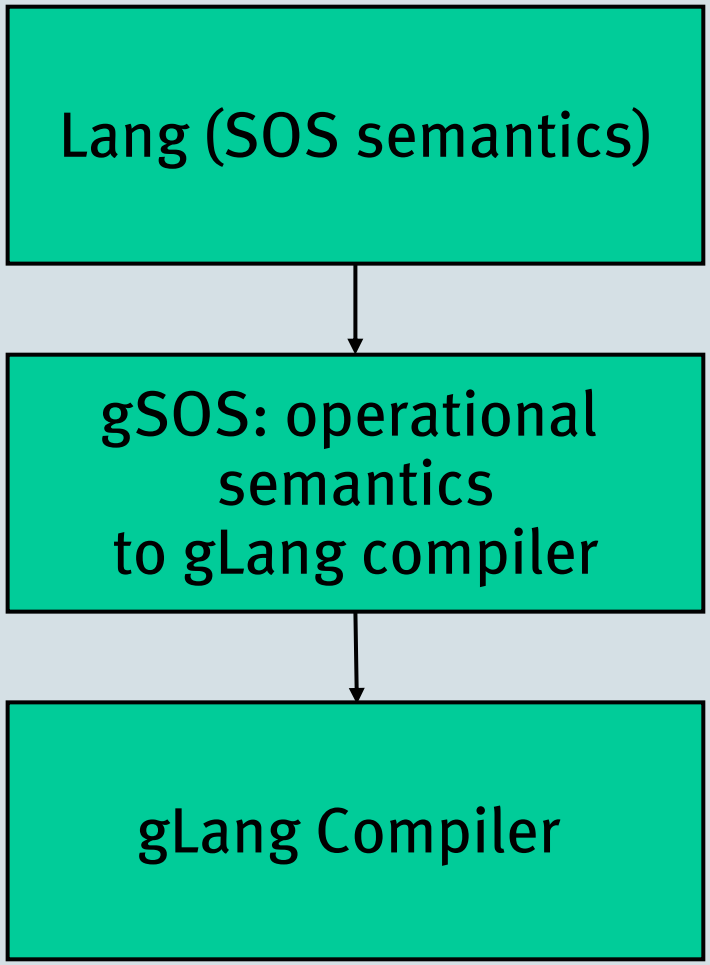
Results

- Congruences for various equalities and preorders
- Conservative extensions
- Induced trace congruences
- Existence of semantics (negative premises)
- Generation of complete axiomatisations
- Generators for simulators
- Various: non-interference; semi-stochasticity;

The *super* rule format

- Terms: simply typed l-calculus?
- Terms as labels!
- Freshness ∇, $a\#t$

Compiler generators from SOS



Lang = Java; C#; C++; π-calculus; mCRL2; Domain and aspect languages;

cf. lex/yacc

Axioms for optimisation

Performance must be comparable to gcc