CoCo participant: CSI

Harald Zankl **Bertram Felgenhauer** Aart Middeldorp

Institute of Computer Science
University of Innsbruck
Austria

1st International Workshop on Confluence
Nagoya, 2012-05-29

About

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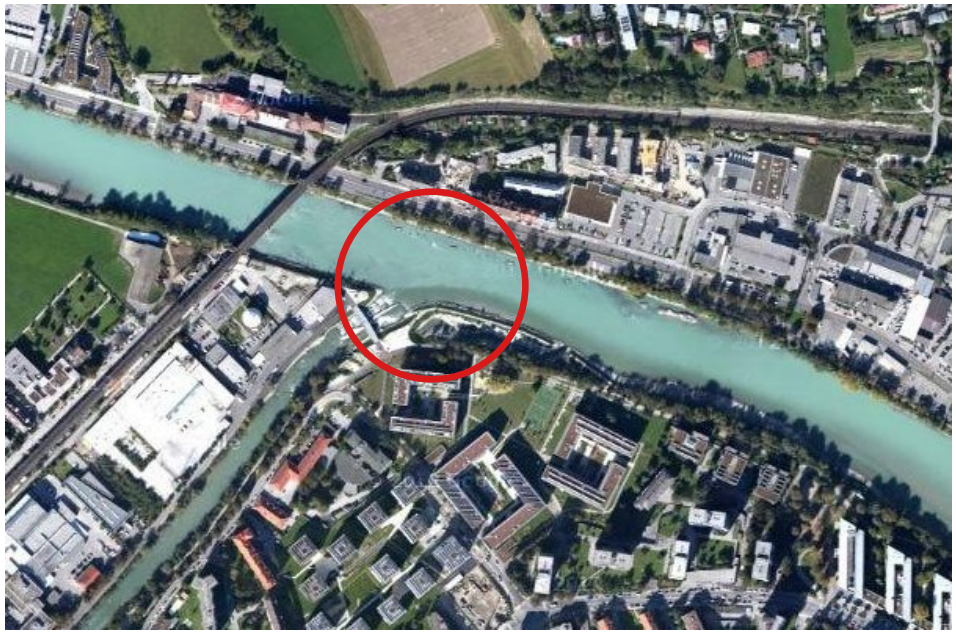
About



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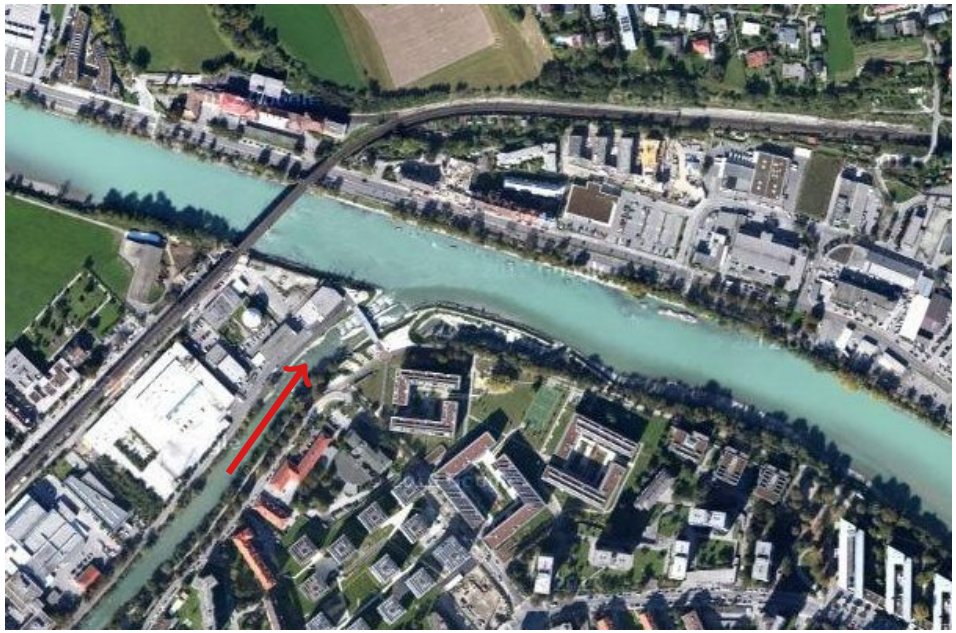

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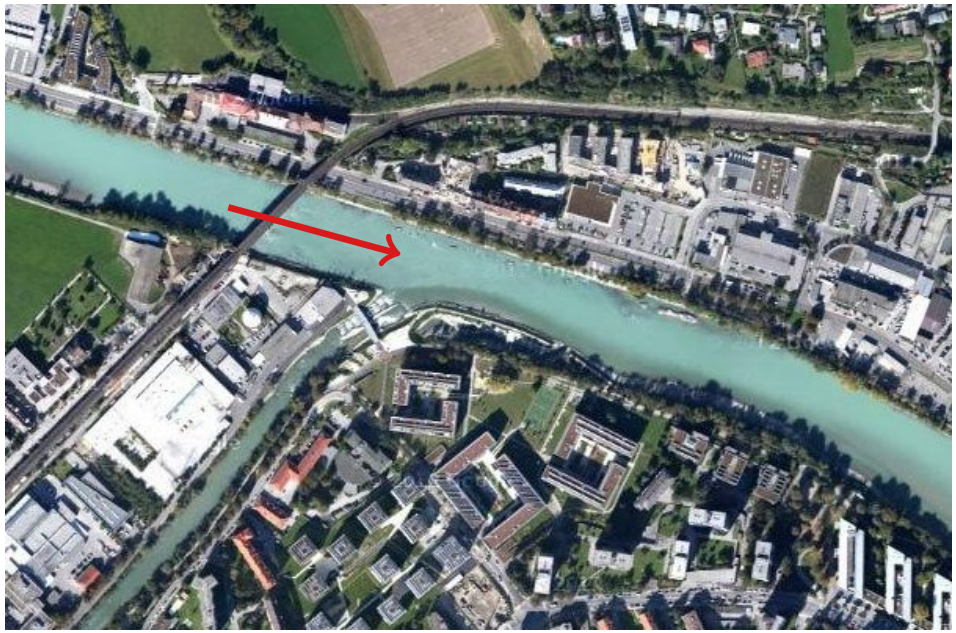

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C S I

- open source confluence tool
- `http://cl-informatik.uibk.ac.at/software/csi/`

Techniques

Theorem (Knuth, Bendix 1970)

If $\mathcal{R}$ is terminating, then $\mathcal{R}$ is confluent iff it is locally confluent.

Observation (Zankl, F., Middeldorp 2011)

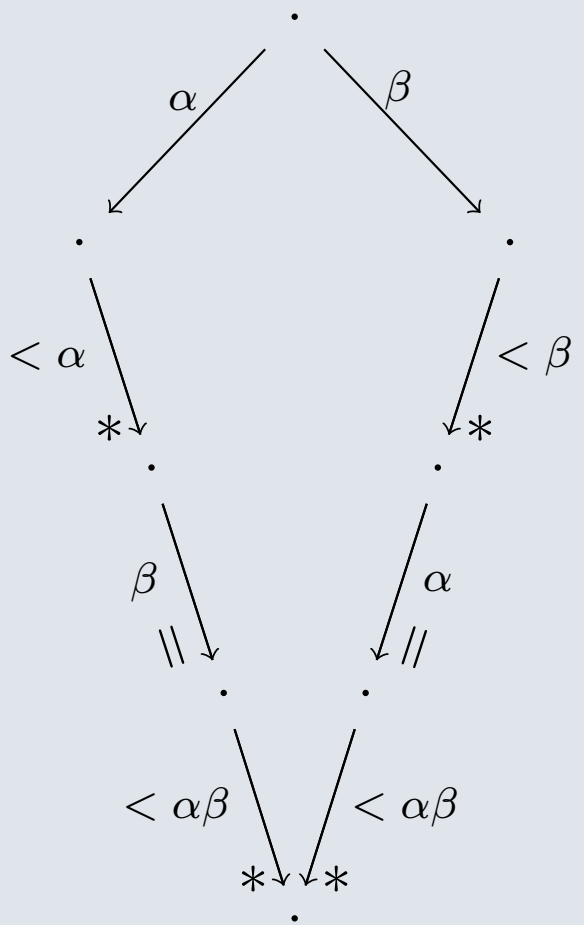
Let $\overline{red}(s)$ be an overapproximation of $\{t \mid s \to^* t\}$.
If $t \;{}^*_{\mathcal{R}}\!\leftarrow s \to^*_{\mathcal{R}} u$ and $\overline{red}(t) \cap \overline{red}(s) = \varnothing$, then $\mathcal{R}$ is not confluent.

Theorem (F. 2012)

If $\mathcal{R}$ is ground, then confluence of $\mathcal{R}$ can be decided in time $O(\|\mathcal{R}\|^3)$.

Techniques: Labelings

Definition



Theorem (Zankl, F., Middeldorp 2011)

left-linear TRS $\mathcal{R}$ is confluent if

- *$\mathcal{R}_d/\mathcal{R}_{nd}$ terminating*
- *critical peaks decreasing (rule labeling)*

Decreasingness

- different labelings
- combine lexicographically
- modular approach

Techniques: Persistent Decomposition

Theorem (F., Zankl, Middeldorp 2011)

A $(\mathcal{S}, \geqslant)$-sorted TRS $\mathcal{R}$ is confluent if

1. *for $\ell \to r \in \mathcal{R}$*
   - *ℓ, r order-sorted, and $\mathsf{sort}(\ell) \geqslant \mathsf{sort}(r)$*
   - *sort of variables in ℓ matches sort of context*
   - *$\mathsf{sort}(r)$ is maximal if $r \in \mathcal{V}$ and $\mathcal{R}$ is non-left-linear and duplicating*
2. *$\mathcal{R}$ is confluent on order-sorted terms*

$\mathcal{R} : \{1\colon \mathsf{f}(x, \mathsf{A}) \to \mathsf{G}(x),\ 2\colon \mathsf{f}(y, \mathsf{G}(y)) \to \mathsf{B},\ 3\colon \mathsf{G}(\mathsf{C}) \to \mathsf{C},\ 4\colon \mathsf{F}(z) \to \mathsf{F}(\mathsf{G}(z))\}$

$f : 4 \times 8 \to 6$	$G : 4 \to 2$	$B : 5$	$x : 4$	$z : 3$
$F : 3 \to 0$	$A : 7$	$C : 1$	$y : 4$	
$4 > 3 > 2 > 1$	$8 > 7, 2$	$6 > 5, 2$		

Decomposition: $\mathcal{R}_1 = \{(1), (2), (3)\}$, $\mathcal{R}_2 = \{(3), (4)\}$

CSI: Features

- Techniques
  - Knuth-Bendix criterion
  - modular approach for labeling decreasing diagrams
  - persistent decomposition based on ordered sorts
  - ground confluence
  - nonconfluence using tcap and tree automata

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Thanks!