

# AGCP: System Description for CoCo 2022

Takahito Aoto

Institute of Science and Technology, Niigata University  
aoto@ie.niigata-u.ac.jp

AGCP (Automated Groud Confluence Prover) [1] is a tool for proving ground confluence of many-sorted term rewriting systems. AGCP is written in Standard ML of New Jersey (SML/NJ). AGCP proves ground confluence of many-sorted term rewriting systems based on two ingredients. One ingredient is to divide the ground confluence problem of a many-sorted term rewriting system  $\mathcal{R}$  into that of  $\mathcal{S} \subseteq \mathcal{R}$  and the inductive validity problem of equations  $u \approx v$  w.r.t.  $\mathcal{S}$  for each  $u \rightarrow r \in \mathcal{R} \setminus \mathcal{S}$ . Here, an equation  $u \approx v$  is inductively valid w.r.t.  $\mathcal{S}$  if all its ground instances  $u\sigma \approx v\sigma$  is valid w.r.t.  $\mathcal{S}$ , i.e.  $u\sigma \xrightarrow{*}_{\mathcal{S}} v\sigma$ . Another ingredient is to prove ground confluence of a many-sorted term rewriting system via the *bounded ground convertibility* of the critical pairs. Here, an equation  $u \approx v$  is said to be bounded ground convertible w.r.t. a quasi-order  $\succsim$  if  $u\theta_g \xrightarrow{*}_{\mathcal{R}} v\theta_g$  for any its ground instance  $u\sigma_g \approx v\sigma_g$ , where  $x \xrightarrow{*}_{\succsim} y$  iff there exists  $x = x_0 \leftrightarrow \dots \leftrightarrow x_n = y$  such that  $x \succsim x_i$  or  $y \succsim x_i$  for every  $x_i$ .

Rewriting induction [3] is a well-known method for proving inductive validity of many-sorted term rewriting systems. In [1], an extension of rewriting induction to prove bounded ground convertibility of the equations has been reported. Namely, for a reduction quasi-order  $\succsim$  and a quasi-reducible many-sorted term rewriting system  $\mathcal{R}$  such that  $\mathcal{R} \subseteq \succ$ , the extension proves bounded ground convertibility of the input equations w.r.t.  $\succsim$ . The extension not only allows to deal with non-orientable equations but also with many-sorted TRSs having non-free constructors. Several methods that add wider flexibility to the this approach are given in [2]: when suitable rules are not presented in the input system, additional rewrite rules are constructed that supplement or replace existing rules in order to obtain a set of rules that is adequate for applying rewriting induction; and an extension of the system of [2] is used if the input system contains non-orientable constructor rules. AGCP uses these extension of the rewriting induction to prove not only inductive validity of equations but also the bounded ground convertibility of the critical pairs. Finally, some methods to deal with disproving ground confluence are added as reported in [2].

No new ground (non-)confluence criterion has been incorporated from the one submitted for CoCo 2021.

## References

- [1] T. Aoto and Y. Toyama. Ground confluence prover based on rewriting induction. In *Proc. of 1st FSCD*, volume 52 of *LIPICs*, pages 33:1–33:12. Schloss Dagstuhl, 2016.
- [2] T. Aoto, Y. Toyama and Y. Kimura. Improving Rewriting Induction Approach for Proving Ground Confluence. In *Proc. of 2nd FSCD*, volume 84 of *LIPICs*, pages 7:1–7:18. Schloss Dagstuhl, 2017.
- [3] U.S. Reddy. Term rewriting induction. In *Proc. of CADE-10*, volume 449 of *LNAI*, pages 162–177. Springer-Verlag, 1990.