Narboux, Julien; Janičić, Predrag; Fleuriot, Jacques

Computer-assisted theorem proving in synthetic geometry.  (English)  Zbl 1425.68377

This is a comprehensive survey of computer-assisted theorem proving in elementary geometries. It is divided into two main parts: (i) automated theorem proving and (ii) interactive theorem proving. In (i) the authors distinguish purely synthetic methods – starting with the first such attempt, going back to [H. Gelernter, Inf. Process., Proc. Int. Conf. Inf. Process. 273–282 (1960; Zbl 0114.06901)], and moving up to the deductive database method, the systems GRAMY and iGeoTutor, systems based on Coherent Logic (such as ArgoCLP), and the resolution theorem prover OTTER – and semisynthetic methods, which, while not using an algebraic formulation of a geometry problem, “express conjectures in terms of certain geometric quantities and prove them by manipulating equalities over expressions in these quantities”, such as the area method, the full angle method, vector-based and mass-point methods.

In (ii) the focus is on “software that can check mathematical assertions interactively”, such as Coq, Isabelle, HOL4, HOL-Light, Mizar, and on work with them in Hilbert’s and in Tarski’s axiomatizations of geometry (such as formalizing large parts of [W. Schwabhäuser et al., Metamathematische Methoden in der Geometrie. Teil I: Ein axiomatischer Aufbau der euklidischen Geometrie. Teil II: Metamathematische Betrachtungen. Berlin etc.: Springer-Verlag (1983; Zbl 0564.51001); Bronx, NY: Ishi Press International (2011; Zbl 1237.51003)].

For the entire collection see [Zbl 1397.05005].

Reviewer: Victor V. Pambuccian (Glendale)

MSC:

68T15  Theorem proving (deduction, resolution, etc.) (MSC2010)
51M05  Euclidean geometries (general) and generalizations
51N20  Euclidean analytic geometry

Keywords:
automated theorem proving; interactive theorem proving; Euclidean geometry

Software:
OTTER; Isabelle; ArgoCLP; Coq; HOL Light; HOL; Mizar