▸ CAMERON ALLETT, *Falsifiers: towards a new proof theory of Hilbert's epsilon-calculus using deep inference.*
Department of Computer Science, University of Bath, Bath, England.
E-mail: ca821@bath.ac.uk.

The *falsifier calculus* [1] has recently been introduced as a new deep-inference proof system for first-order predicate logic in the language of Hilbert's epsilon-calculus. It uses a new inference rule, the falsifier rule, to introduce epsilon-terms into a proof, distinct from the critical axioms of the traditional epsilon-calculus. The falsifier rule is a generalisation of one of the quantifier-shifts, inference rules for shifting quantifiers inside and outside of formulae. Like the epsilon-calculus and proof systems which include quantifier-shifts, the falsifier calculus admits non-elementarily smaller cut-free proofs of certain first-order theorems than Gentzen's sequent calculus.

Analogous to the way in which Herbrand's Theorem decomposes a proof into a first-order and a propositional part, connected by a Herbrand disjunction as an intermediate formula, the falsifier calculus provides a new decomposition theorem for first-order proofs which gives rise to a new notion of intermediate formula in the epsilon-calculus, falsifier disjunctions. Certain first-order theorems admit non-elementarily smaller falsifier disjunctions than Herbrand disjunctions and current research efforts are towards formalising the connection between the two theorems, in the hopes of developing a novel method of epsilon substitution using the falsifier calculus.

This talk will overview the established work on the falsifier calculus and explore the ongoing research into using the falsifier calculus as a means of extracting Herbrand disjunctions from first-order proofs.

[1] Cameron Allett, *Non-Elementary Compression of First-Order Proofs in Deep Inference Using Epsilon-Terms*, ***Proceedings of the 39th Annual ACM/IEEE Symposium on Logic in Computer Science (LICS 2024)***, Tallinn, Estonia, Association for Computing Machinery, 2024.