

Nested sequents for modal logics and beyond

Sonia Marin

In this talk, we will review the different ways *nested sequents* have been used to give cut-free deductive systems for various logics, in particular many that cannot be handled in ordinary (Gentzen) calculi, and other applications as interpolation results, realisation theorems for justification logics, etc.

References

- [1] Régis Alenda, Nicola Olivetti, and Gian Luca Pozzato. Nested sequent calculi for conditional logics. In *Logics in Artificial Intelligence*. Springer, 2012.
- [2] Ryuta Arisaka, Anupam Das, and Lutz Straßburger. On nested sequents for constructive modal logics. *Logical Methods in Computer Science*, 11(3), 2015.
- [3] Marta Bílková. A note on uniform interpolation proofs in modal deep inference calculi. In *International Tbilisi Symposium on Logic, Language, and Computation*, pages 30–45. Springer, 2009.
- [4] Annemarie Borg and Roman Kuznets. Realization theorems for justification logics: Full modularity. In *International Conference on Automated Reasoning with Analytic Tableaux and Related Methods*, pages 221–236. Springer, 2015.
- [5] Kai Brünnler. Deep sequent systems for modal logic. *Archive for Mathematical Logic*, 48(6):551–577, 2009.
- [6] Kai Brünnler. How to universally close the existential rule. In *Logic for Programming, Artificial Intelligence, and Reasoning*, volume 6397 of *Lecture Notes in Computer Science*, pages 172–186. Springer, 2010.
- [7] Kai Brünnler. *Nested Sequents*. Habilitation thesis, Universität Bern, 2010.
- [8] Kai Brünnler and Thomas Studer. Syntactic cut-elimination for common knowledge. *Annals of Pure and Applied Logic*, 160(1):82 – 95, 2009.
- [9] Kai Brünnler and Thomas Studer. Syntactic cut-elimination for a fragment of the modal mu-calculus. *Annals of Pure and Applied Logic*, 163(12):1838–1853, 2012.

- [10] Kaustuv Chaudhuri, Sonia Marin, and Lutz Straßburger. Focused and synthetic nested sequents. In *International Conference on Foundations of Software Science and Computation Structures*, pages 390–407. Springer, 2016.
- [11] Kaustuv Chaudhuri, Sonia Marin, and Lutz Straßburger. Modular focused proof systems for intuitionistic modal logics. In *LIPICs-Leibniz International Proceedings in Informatics*, volume 52. Schloss Dagstuhl-Leibniz-Zentrum fuer Informatik, 2016.
- [12] Agata Ciabattoni, Nikolaos Galatos, and Kazushige Terui. From axioms to analytic rules in nonclassical logics. In *Logic in Computer Science, 2008. LICS'08. 23rd Annual IEEE Symposium on*, pages 229–240. IEEE, 2008.
- [13] Roy Dyckhoff, Mehrnoosh Sadrzadeh, and Julien Truffaut. Algebra, proof theory and applications for a logic of propositions, actions and adjoint modal operators. *Electronic Notes in Theoretical Computer Science*, 286:157–172, 2012.
- [14] Melvin Fitting. Nested sequents for intuitionistic logics. *Notre Dame Journal of Formal Logic*, 55(1):41–61, 2014.
- [15] Melvin Fitting and Roman Kuznets. Modal interpolation via nested sequents. *Annals of pure and applied logic*, 166(3):274–305, 2015.
- [16] Remo Goetschi and Roman Kuznets. Realization for justification logics via nested sequents: Modularity through embedding. *Annals of Pure and Applied Logic*, 163(9):1271–1298, 2012.
- [17] Rajeev Goré, Linda Postniece, and Alwen Tiu. Cut-elimination and proof-search for bi-intuitionistic logic using nested sequents. *Advances in Modal Logic*, 7:43–66, 2008.
- [18] Rajeev Goré and Revantha Ramanayake. Labelled tree sequents, tree hypersequents and nested (deep) sequents. *Advances in modal logic*, 9:279–299, 2012.
- [19] Nicolas Guenot. *Nested Deduction in Logical Foundations for Computation*. PhD thesis, Ecole Polytechnique X, 2013.
- [20] Brian Hill and Francesca Poggiolesi. A contraction-free and cut-free sequent calculus for propositional dynamic logic. *Studia Logica*, 94(1):47–72, 2010.
- [21] Ryo Kashima. Cut-free sequent calculi for some tense logics. *Studia Logica*, 53(1):119–135, 1994.
- [22] Hidenori Kurokawa. Hypersequent calculi for modal logics extending S4. In *JSAI International Symposium on Artificial Intelligence*, pages 51–68. Springer, 2013.

- [23] Roman Kuznets, Sonia Marin, and Lutz Straßburger. Justification logic for constructive modal logic. In *IMLA 2017-7th Workshop on Intuitionistic Modal Logic and Applications*, 2017.
- [24] Björn Lellmann. Linear nested sequents, 2-sequents and hypersequents. In *International Conference on Automated Reasoning with Analytic Tableaux and Related Methods*, pages 135–150. Springer, 2015.
- [25] Björn Lellmann, Carlos Olarte, and Elaine Pimentel. A uniform framework for substructural logics with modalities. *LPAR-21*, pages 435–455, 2017.
- [26] Björn Lellmann and Elaine Pimentel. Proof search in nested sequent calculi. In *Logic for Programming, Artificial Intelligence, and Reasoning*, pages 558–574. Springer, 2015.
- [27] Sonia Marin and Lutz Straßburger. Label-free modular systems for classical and intuitionistic modal logics. In *Advances in Modal Logic 10*, 2014.
- [28] Elaine Pimentel. Proof systems: from nestings to sequents and back. *arXiv preprint arXiv:1802.04704*, 2018.
- [29] Francesca Poggiolesi. The method of tree-hypersequents for modal propositional logic. In *Towards mathematical philosophy*, pages 31–51. Springer, 2009.
- [30] Revantha Ramanayake. Embedding the hypersequent calculus in the display calculus. *Journal of Logic and Computation*, 25(3):921–942, 2015.
- [31] Mehrnoosh Sadrzadeh and Roy Dyckhoff. Positive logic with adjoint modalities: Proof theory, semantics, and reasoning about information. *The Review of Symbolic Logic*, 3(3):351–373, 2010.
- [32] Daniyar Shamkanov. Nested sequents for provability logic GLP. *Logic Journal of the IGPL*, 23(5):789–815, 2015.
- [33] Lutz Straßburger. Cut elimination in nested sequents for intuitionistic modal logics. In *International Conference on Foundations of Software Science and Computational Structures*, pages 209–224. Springer, 2013.
- [34] Lutz Straßburger and Roman Kuznets. Maehara-style Modal Nested Calculi. Technical report, Inria Saclay, November 2017.
- [35] Alwen Tiu, Egor Ianovski, and Rajeev Goré. Grammar logics in nested sequent calculus: Proof theory and decision procedures. In *Advances in Modal Logic*, 2012.
- [36] Alwen F Tiu, Linda Postniece, and Rajeev Gore. On the correspondence between display postulates and deep inference in nested sequent calculi for tense logics. *Logical Methods in Computer Science*, 7, 2011.