# Preface

The Workshop and International Conference on Representations of Algebras (ICRA 2020) was hosted by NTNU in Trondheim, Norway, and held online during November 9–25, 2020. Originally, the plan was to have a physical conference at ICTP/Trieste, Italy, in the summer of 2020, but this was cancelled due to the pandemic. ICRA2020 was the 19th in a series of international conferences which started 1974 in Ottawa.

ICRA2020 consisted of a workshop with five lecture series and a conference with ten invited lectures, including the talks of the two ICRA-award winners. There were no parallel sessions, but all participants were encouraged to submit research snapshots. These were made public for the participants, and based on these, the scientific committee invited six lectures to be held in the FD Seminar, a weekly online seminar on representation theory of quivers and finite-dimensional algebras.

The scientific committee for ICRA2020 consisted of: Javad Asadollahi, Christof Geiss, Osamu Iyama, Bernhard Keller, Steffen Oppermann (leader), Julia Pevtsova, Ralf Schiffler, Sibylle Schroll and Jan Trlifaj.

The organizing committee consisted of: Lidia Angeleri Hügel, Aslak Bakke Buan (leader), Gustavo Jasso, Henning Krause, Rosanna Laking and Øyvind Solberg.

Two mathematicians were awarded the ICRA Award 2020, for outstanding work by young mathematicians in the field of representations of finite-dimensional algebras. Fan Qin was given the award for his contributions to both additive and monoidal categorification of cluster algebras, and in particular for his proofs of several important conjectures, including Fomin–Zelevinsky's cluster monomial conjecture in the skew-symmetrizable case. Simone Virili was given the award for his fundamental and pioneering work on using derivators in representation theory, in particular for developing a Morita theory for stable derivators, and for major contributions on torsion pairs and hearts of t-structures. Both award winners have contributed to these proceedings.

This book aims to present the content of some of these lectures to a wider audience, and contains 13 papers.

In the paper by Amiot, representations of skew-gentle algebras are studied using topological tools. To such an algebra $A$, one associates an orbifold surface and obtains a complete description of indecomposable objects of the bounded derived category of $A$ in terms of graded curves on the associated orbifold.

Asai's paper studies the wall and chamber structure on the real Grothendieck group of an algebra. The chambers in this structure are the open cones associated to the basic 2-term silting objects in the perfect derived category of the algebra.

The paper of Balmer and Gallauer is devoted to the study of permutation modules, Mackey functors, and Artin motives. The authors explain in detail the connections between these three concepts, and they discuss how the 'big' derived category of permutation modules introduced earlier fits into the picture.

The paper by Botnan and Lesnick gives an introduction to multiparameter persistent homology. It surveys various recent developments. It also serves as an introduction for readers with a background in basic category theory, homology, and abstract algebra, but does not require a background in topological data analysis.

In the paper of Cummings, the following question is discussed: Considering a triangulated subcategory of the derived category of a ring that contains the injective modules and is closed under infinite coproducts, when is this the entire derived category? The question is strongly related to the finitistic dimension conjecture, and it is in this paper particularly discussed for rings that appear in the same recollement diagram.

Erdmann's contribution is the paper "Tame algebras: some work of Andrzej Skowroński". Some of the highlights from Skowroński's research on tame algebras are presented. In particular, it deals with selfinjective algebras, and the special class of symmetric algebras called *weighted surface algebras*. Also covering theory for tame algebras is discussed.

The paper of Etingof and Kannan is based on the workshop lectures of the first author. The subject are symmetric tensor categories, which arise naturally in representation theory, for instance in the study of representations of finite supergroup schemes. The authors review some aspects of the current state of the theory of symmetric tensor categories and discuss their applications.

The paper by Gnedin, Iyengar and Krause deals with a class of Gorenstein algebras over commutative noetherian rings which was recently introduced and studied by Iyengar and Krause. This work represents a branch within representation theory that is highly inspired by commutative algebra; it builds on classical groundbreaking work of Ragnar-Olaf Buchweitz.

In the paper by Keller and Wang, absolute and relative Calabi–Yau completions and Calabi–Yau structures are studied. It contains a short overview of dg categories and their Hochschild and cyclic homologies, and examples of absolute and relative Calabi–Yau completions relevant for (higher) representation theory of finite-dimensional algebras.

Ladkani's paper deals with methods for computation of Coxeter polynomials of algebras. Some applications are given, including new symmetry properties for Coxeter polynomials of ordinal sums of posets, constructions of new algebras of cyclotomic type and interlaced towers of algebras.

Qin's paper gives a brief introduction to (upper) cluster algebras and their quantization using examples.Then various families of bases for such algebras are given, using topological models. Tropical properties of these bases and their relation to representation theory are also discussed.

In the paper by Virili, an alternative proof of a recent result of Hanfeng Li and Bingbing Liang is given. Given a left Noetherian ring $R$ and a sofic group $G$, it is shown that the group ring $R[G]$ is stably finite. The proof depends on localization theory of Grothendieck categories.

The paper by Williams discusses the higher Stasheff–Tamari orders. These are two orders on triangulations of cyclic polytopes. Interpretations in terms of natural orders on tilting modules are given, and a higher-dimensional generalization of maximal green sequences is studied.

It is a pleasure to thank all those who contributed to this volume, either by submitting their work or by refereeing it. In addition, we wish to thank Apostolos Damialis of the EMS Press for his help in preparing the volume for publication.

Bielefeld and Trondheim, June 2023

Aslak Bakke Buan
Henning Krause
Øyvind Solberg