



# THEORY AND APPLICATIONS OF CATEGORIES

Volume 23, 2010

*The Bourn Festschrift:*

*A special volume dedicated to*

*Dominique Bourn*

*on the occasion of his 60'th birthday.*

Foreword	
The guest editors	1
Action accessibility for categories of interest	
Andrea Montoli	7
Homology of n-fold groupoids	
Tomas Everaert and Marino Gran	22
The comprehensive factorization and torsors	
Ross Street and Dominic Verity	42
Snake Lemma in incomplete relative homological categories	
Tamar Janelidze	76
Monadic approach to Galois descent and cohomology	
Francis Borceux, Stefaan Caenepeel and George Janelidze	92
Internal crossed modules and Peiffer Condition	
Sandra Mantovani, Giuseppe Metere	113

---

The Editors of TAC wish to thank Andree Ehresmann, George Janelidze, Jiri Rosicky, Walter Tholen and Enrico Vitale who acted as guest editors for this special volume.

© The Editors of Theory and Applications of Categories 2010. Permission to copy for private use granted.

Strongly separable morphisms in general categories G. Janelidze and W. Tholen	136
The third cohomology group classifies double central extensions Diana Rodelo and Tim Van der Linden	150
Star-multiplicative graphs in pointed protomodular categories N. Martins-Ferreira	170
A metric tangential calculus Elisabeth Burroni and Jacques Penon	199
The pointed subobject functor, $3 \times 3$ lemmas, and subtractivity of spans Zurab Janelidze	221
A categorical approach to integration Reinhard Brger	243
What are sifted colimits? J. Adamek, J. Rosicky, E. M. Vitale	251

THEORY AND APPLICATIONS OF CATEGORIES (ISSN 1201-561X) will disseminate articles that significantly advance the study of categorical algebra or methods, or that make significant new contributions to mathematical science using categorical methods. The scope of the journal includes: all areas of pure category theory, including higher dimensional categories; applications of category theory to algebra, geometry and topology and other areas of mathematics; applications of category theory to computer science, physics and other mathematical sciences; contributions to scientific knowledge that make use of categorical methods.

Articles appearing in the journal have been carefully and critically refereed under the responsibility of members of the Editorial Board. Only papers judged to be both significant and excellent are accepted for publication.

Full text of the journal is freely available in .dvi, Postscript and PDF from the journal's server at <http://www.tac.mta.ca/tac/> and by ftp. It is archived electronically and in printed paper format.

**SUBSCRIPTION INFORMATION.** Individual subscribers receive by e-mail abstracts of articles by e-mail as they are published. To subscribe, send e-mail to [tac@mta.ca](mailto:tac@mta.ca) including a full name and postal address. For institutional subscription, send enquiries to the Managing Editor.

**INFORMATION FOR AUTHORS.** The typesetting language of the journal is  $\text{\TeX}$ , and  $\text{\LaTeX} 2_{\epsilon}$  is strongly encouraged. Articles should be submitted by e-mail directly to a Transmitting Editor. Please obtain detailed information on submission format and style files from <http://www.tac.mta.ca/tac/>.

Managing editor. Robert Rosebrugh, Mount Allison University: [rrosebrugh@mta.ca](mailto:rrosebrugh@mta.ca)

$\text{\TeX}$ nical editor. Michael Barr, McGill University: [barr@math.mcgill.ca](mailto:barr@math.mcgill.ca)

Assistant  $\text{\TeX}$  editor. Gavin Seal, Ecole Polytechnique Fédérale de Lausanne: [gavin\\_seal@fastmail.fm](mailto:gavin_seal@fastmail.fm)

Transmitting editors.

Clemens Berger, Université de Nice-Sophia Antipolis, [cberger@math.unice.fr](mailto:cberger@math.unice.fr)

Richard Blute, Université d' Ottawa: [rblute@uottawa.ca](mailto:rblute@uottawa.ca)

Lawrence Breen, Université de Paris 13: [breen@math.univ-paris13.fr](mailto:breen@math.univ-paris13.fr)

Ronald Brown, University of North Wales: [ronnie.profbrown \(at\) btinternet.com](mailto:ronnie.profbrown@btinternet.com)

Aurelio Carboni, Università dell' Insubria: [aurelio.carboni@uninsubria.it](mailto:aurelio.carboni@uninsubria.it)

Valeria de Paiva, Cuill Inc.: [valeria@cuill.com](mailto:valeria@cuill.com)

Ezra Getzler, Northwestern University: [getzler\(at\)northwestern\(dot\)edu](mailto:getzler@northwestern.edu)

Martin Hyland, University of Cambridge: [M.Hyland@dpms.cam.ac.uk](mailto:M.Hyland@dpms.cam.ac.uk)

P. T. Johnstone, University of Cambridge: [ptj@dpms.cam.ac.uk](mailto:ptj@dpms.cam.ac.uk)

Anders Kock, University of Aarhus: [kock@imf.au.dk](mailto:kock@imf.au.dk)

Stephen Lack, University of Western Sydney: [s.lack@uws.edu.au](mailto:s.lack@uws.edu.au)

F. William Lawvere, State University of New York at Buffalo: [wlawvere@acsu.buffalo.edu](mailto:wlawvere@acsu.buffalo.edu)

Tom Leinster, University of Glasgow, [T.Leinster@maths.gla.ac.uk](mailto:T.Leinster@maths.gla.ac.uk)

Jean-Louis Loday, Université de Strasbourg: [loday@math.u-strasbg.fr](mailto:loday@math.u-strasbg.fr)

Ieke Moerdijk, University of Utrecht: [moerdijk@math.uu.nl](mailto:moerdijk@math.uu.nl)

Susan Niefield, Union College: [niefiels@union.edu](mailto:niefiels@union.edu)

Robert Paré, Dalhousie University: [pare@mathstat.dal.ca](mailto:pare@mathstat.dal.ca)

Jiri Rosicky, Masaryk University: [rosicky@math.muni.cz](mailto:rosicky@math.muni.cz)

Brooke Shipley, University of Illinois at Chicago: [bshipley@math.uic.edu](mailto:bshipley@math.uic.edu)

James Stasheff, University of North Carolina: [jds@math.unc.edu](mailto:jds@math.unc.edu)

Ross Street, Macquarie University: [street@math.mq.edu.au](mailto:street@math.mq.edu.au)

Walter Tholen, York University: [tholen@mathstat.yorku.ca](mailto:tholen@mathstat.yorku.ca)

Myles Tierney, Rutgers University: [tierney@math.rutgers.edu](mailto:tierney@math.rutgers.edu)

Robert F. C. Walters, University of Insubria: [robert.walters@uninsubria.it](mailto:robert.walters@uninsubria.it)

R. J. Wood, Dalhousie University: [rjwood@mathstat.dal.ca](mailto:rjwood@mathstat.dal.ca)