

Computer-Assisted Research Mathematics and its Applications (CARMA) Present and Future

CARMA PRC is known internationally for research that advances knowledge of fundamental mathematics and the application of mathematical methods – with especial emphasis on the intelligent use of modern computing and information technology. CARMA, identified as one of two 'Australian mathematical hotspots' by the Australian Mathematical Science Institute, links the national and international mathematical community with the local and University of Newcastle communities.

Researchers of international stature lead CARMA-supported programs in a diversity of areas. The *number theory* group has become Australia's most prominent in the field. Another group of CARMA researchers spearhead a burgeoning international program focused on important *group theory* (0-dimensional groups, or the '*symmetry* of cyberspace'); a program inspired by a breakthrough made 20 years ago in Newcastle.

A diverse group doing world class *discrete mathematics* also plays a central role in CARMA. CARMA director Borwein is a world-renowned optimization specialist who directs a strong group in *nonlinear analysis* and *optimization*, which at the applications level engages with medical and physical scientists, engineers, financial mathematicians and researchers and practitioners in many other related areas.

The *application of mathematics* is advanced by CARMA researchers who develop and use tools for the modelling of solid structures, the interaction between fluid waves and semi-elastic bodies, the transmission of information, and the spread of disease. This research has an important impact on, for example, the design of container ships and the control of tuberculosis in New Guinea.

New technologies (for *communication and collaboration*, *visualisation* and *computation*) are radically changing student needs and expectations and the nature of mathematics instruction, the nexus between research and teaching, and modern publishing practices. At the same time, rapidly advancing computing power is challenging the meaning of mathematical truth and how it is discovered, while advances in neuroscience offer insights into the human side of mathematics.

These changes are transforming the mathematical profession and the conduct of mathematical research itself. CARMA is at the forefront of this transformation through its engagement with professional bodies and publishing, and its championing of experimental mathematics and collaborative technology.

CARMA attracts a large number of short and longer term visits by high profile mathematicians from around the world. This lends itself to a vibrant program of workshops, mini lecture series and seminars often shared with wider national and international participation via its Access Grid facilities.

Other outreach activities of CARMA showcase to the local community the excitement of international mathematical discovery and the effectiveness of mathematical methods. The opportunity to engage in the enterprise of mathematics is offered to members of the local community through CARMA and the University.

CARMA's high profile and multifaceted nature makes it an ideal environment to attract and train research students of the highest calibre. Indeed, CARMA currently sits in a top 200 Mathematics 'department' globally and aims to offer a top 100 environment.