

**Art Karshmer Lectures in Access to  
Mathematics, Science and Engineering**

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## Introduction to the Special Thematic Session

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**Abstract.** This session is the continuation of the STS started by Pr Arthur I. Karshmer at ICCHP since 2002. It intends to bring together experts from around the world to present and discuss the state of the art, the actual research and development activities and the future perspectives in access to mathematics, science and statistics. Its aim is to find ways how the potential of ICT and AT could lead to advancements in education and career of disabled students, in particular, those with a print disability, in fields where advanced skills in mathematics are necessary.

**Keyword:** Accessibility to mathematics

*In memoriam of Pr Arthur I. Karshmer, the founder and long serving chair of this STS.*

## 1 A Few Words About Art

Professor Arthur I. Karshmer, our dear colleague, mentor and Computer Science guru, started a thematic session about access to Mathematics and Science at ICCHP in 2002 in Linz. He intended to have a session presenting “*new approaches to offer blind students a better access to math, to provide tools for doing math as well as to support teachers in teaching math.*”

Since 2002, a session about access to Mathematics has always been present at ICCHP conference, chaired by Art. The Table 1 underlines that the STS founded and chaired by Art is one of the few and longer lasting series of references in this domain.

Art started to work in the area of Assistive Technologies in the mid 1980s [6] and was one of the first researchers to wonder how students with visual impairment could access to mathematical notation, and therefore to STEM subjects (Science, Technology, Engineering and Mathematics) [4]. Then he carried on a lot of researches to find ways to help them to understand formulas and to do calculations, and more widely to

**Table 1.** The “Access to Maths” STS at ICCHP since 2002

Conference		Title of the session	Papers
2002	Linz	<i>Access to Mathematics for Blind Students</i>	8
2004	Paris	<i>Blind People: Access to Mathematics</i>	12
2006	Linz	<i>Blind People: Access to Mathematics</i>	11
2008	Linz	<i>Access to Mathematics and Science</i>	15
2010	Vienna	<i>Blind and Partially Sighted People: Access to Mathematics</i>	6
2012	Linz	<i>Access to Mathematics and Science</i>	13
2014	Paris	<i>Access to Mathematics, Science and Music</i>	15
			<b>80</b>

learn Mathematics. He made several breakthrough in this domain and especially when he invented the idea of navigation within a formula using meaningful chunks, which came after studying how people understand Mathematics [5]. Very pragmatic, he understood very early the necessity to work in multi-disciplinary team, with colleagues from other disciplines, like psychology [3].

He was convinced that researchers need to meet, to share, to discuss: that’s how new ideas come. He had an incredible number of visits in labs all around the world as invited professor or researcher. There, he would stay a few weeks, taking part of the laboratory life, advising Master and PhD students, giving a few talks and working on his mathematical software. Thereby he came to Paris, Nice, Linz, Finland, Spain, and lots of other places.

He created the STS in 2002 and at the same period he invited us to form a group, that we called iGUMA, for *International Group for Universal Maths Access*, including our teams from Florida, New Mexico, Texas, Dublin, Linz and Paris, soon joined by the infy group in Japan. This group was at the origin of the idea of working on a Universal Maths Conversion Library [2].

Two years ago Art chaired his last ICCHP session in Paris, where he was awarded, together with Pr Masakazu Suzuki, by the seventh ICCHP Roland Wagner Award.

Art was an outstanding researcher, an extraordinary pedagogue, who knew how to build on students knowledge to make them progress, and excellent speaker, who caught immediately his audience. But Art was also a wonderful friend. We were meeting all around, in Linz, Paris, San Francisco or anywhere else, like in his house in Tampa. Whatever time since last meeting, he always add new questions for you, new things he wanted to understand, but also he wanted to understand what you think of this or that, with your different culture and background.

Art passed away in November 2015. We miss him as a friend and researcher. ICCHP and the panel of experts in access to math and science he composed decided to dedicate this session to the memory of Art. We see it as our responsibility to keep its heritage up to date and bring it into the future.

## 2 The 2016 Session

The 2016 session is dedicated to Art. This year we will have 9 papers, 6 from 6 different European countries, one from the USA and 2 from Japan. 6 of these papers are focused on mathematics itself while 2 are about programming, and one about access to chemistry.

Several years ago, we introduced the following classification of works in the topic of access to Mathematics and Science [1], which appeared successively during the last 2 decades:

1. **accessing:** access to mathematical content, including conversion tools, OCR, *etc.*
2. **understanding:** how to understand mathematical content, including formula browsers, *etc.*
3. **doing:** solving mathematical problems, doing mathematics.

In this session, we have 3 papers about the first category, “*accessing*” including 2 about OCR of mathematical documents:

- *Recognition of E-Born PDF Including Mathematical Formulas*, Masakazu Suzuki and Katsuhito Yamaguchi, Japan;
- *Artificial neural networks and fuzzy logic for recognizing alphabet characters and mathematical symbols*, by Giuseppe Airó Farulla, Tiziana Armano, Anna Capietto, Nadir Murru, and Rosaria Rossini, Italy;

And one about converting mathematical content into different mathematical braille codes

- *Braille Math extension to RoboBraille - A universal software solution for converting mathematical documents into Braille*, by Vlad Paul Cosma, Tanja Stevns and Lars Ballieu Christensen, Denmark;

Then 5 papers can be classified into the second category: “*understanding*”, where 2 are about mathematical text-to-speech

- *An Evaluation Methodology of Math-to-Speech in non-English DAISY Digital Talking Books*, by Paraskevi Riga, Georgios Kouroupetroglou, and Polyxeni-Parthena Ioannidou, Greece;
- *Navigation of Mathematical Expressions Using Speech*, by Neil Soiffer, United States;

One about didactics of mathematics:

- *Analysis of Implicit Didactics in Math Schoolbooks for Interactive Non-visual User Interface Development*, by Prajaks Jitngernmadan, Andrea Petz, Bernhard Stöger, and Klaus Miesenberger, Austria;

And two papers about how to design accessible documents, in chemistry, and in computer modelisation.

- *Polyfilling Accessible Chemistry Diagrams*, by Volker Sorge, United Kingdom;

- *Guidelines for Accessible Textual UML Modeling Notations*, by Vanessa Petrausch and Stephan Seifermann, Germany;

Finally the last paper is about “*doing*”, with a method to teach programming using tangible objects.

- *Tangible Programming Gimmick using RFID Systems Considering the Use of Visually Impairments*, by Tatsuo Motoyoshi, Naoki Tetsumura, Hiroyuki Masuta, Kenihci Koyanagi, Toru Oshima and Hiroshi Kawakami, Japan.

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