



## Mathematics Enters the Picture

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### ABSTRACT

In 1944, near the end of World War II, an allied bombing campaign destroyed the Eremitani church in Padua, Italy. The church was famous among art lovers for its magnificent frescoes, which included a series by the early renaissance painter Andrea Mantegna (1431-1506). Over 88.000 small pieces of painted plaster, of an average area of only 2 square centimeters, had been lovingly collected and conserved after the bombing; together, they accounted for less than 80 square meters - only a very small fraction of the area covered by the frescoes originally. From 1992 onwards, art conservation experts attacked the task of cleaning and photographing every piece, sorting them and hoping to reconstruct at least some fragments. The herculean task seemed hopeless - until mathematics came to the rescue. We present a rotation invariant pattern matching approach that made it possible, for each small piece of plaster that still showed an element of the design of the fresco, to find where it belonged exactly. The resulting very fragmented and mosaic-like reconstruction of the color scheme of each fresco was then used, via another algorithm based on variational methods, to fill in the color information for the whole fresco. We show eventually as the techniques developed to solve the puzzle can be used also towards other problems in mathematical imaging.

Reference: <http://people.ricam.oeaw.ac.at/m.fornasier/mathsinpict.pdf>

### BIOGRAPHY

The research of **Massimo Fornasier** embraces a broad spectrum of problems in mathematical modeling, analysis and numerical analysis. Fornasier is particularly interested in the concept of compression as appearing in different forms in data analysis, image and signal processing, and in the adaptive numerical solutions of partial differential equations or high-dimensional optimization problems.

Fornasier received his doctoral degree in computational mathematics in 2003 from the University of Padua, Italy. After spending from 2003 to 2006 as a postdoctoral research fellow at the University of Vienna and University of Rome La Sapienza, he joined the Johann Radon Institute for Computational and Applied Mathematics (RICAM) of the Austrian Academy of Sciences where he served as a senior research scientist until March 2011. He was an associate researcher from 2006 to 2007 for the Program in Applied and Computational Mathematics of Princeton University, USA. In 2011 he was appointed Chair of Applied Numerical Analysis at TUM. Massimo Fornasier is the author of ca 70 research papers. He supervised the study and the research of 7 doctoral students and 14 postdocs. He is a member of VQR, a panel responsible for the evaluation of the quality of research in Italy. He is also a member of the editorial boards of several prestigious journals. He received national and international honors and awards such as the invitation as a Speaker at the 7th European Congress of Mathematics in Berlin in 2016, the ERC-Starting Grant in 2012, the Biennial SIMAI prize in 2012, the START-award of the Austrian Science Fund in 2011, the Best Paper Award of the Austrian Academy of Sciences in 2010 and the Prix de Boelpaepe for image processing from the Royal Academy of Science, Letters and Fine Arts of Belgium in 2008.