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## Italian scientists to piece together bomb-damaged church frescoes

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Scientists at the Physics Institute at the University of Padua have developed techniques to recreate frescoes damaged by stray bombs in the second world war.

A raid by 100 American Flying Fortresses on the Padua marshalling yards in 1944 completely destroyed the Ovetari Chapel of the Eremitani Church and pulverised 15th-century Andrea Mantegna frescoes.

The scientists will recreate the frescoes from 80,735 surviving fragments, using a set of black-and-white photographs of the chapel taken in the 1920s.

After the bombing, the shattered pieces - the smallest the size of a farthing, the largest that of a cigarette packet - were clawed out of the rubble by the citizens of Padua. They were packed in wooden crates and, as war-torn Italy struggled back to normality, were taken to the Central Restoration Institute in Rome. In 1946 a few large pieces were reassembled, but most were deemed too small and remained in their boxes for half a century.

The project, led by physicist Domenico Toniolo and mathematician Massimo Fornasier, hinges on a special computer program that compares the black-and-white photographs with the surviving fragments.

"It uses pattern-matching techniques based on circular harmonics. In plain language, the original photographs are scanned, the fragments are photographed and scanned, and the program then searches for the exact location of each piece," Professor Fornasier said.

After the war, the Ovetari Chapel was rebuilt and the larger pieces were put back in place. But these are only a small section of the original frescoes. The fragments that Padua is working on amount to a total of 77m<sup>2</sup>, about 10 per cent of the rest of the original area.

"Our aim is a virtual recreation of the frescoes. This should be done by late 2004, and will be the basis for a physical reconstruction," Professor Fornasier said.