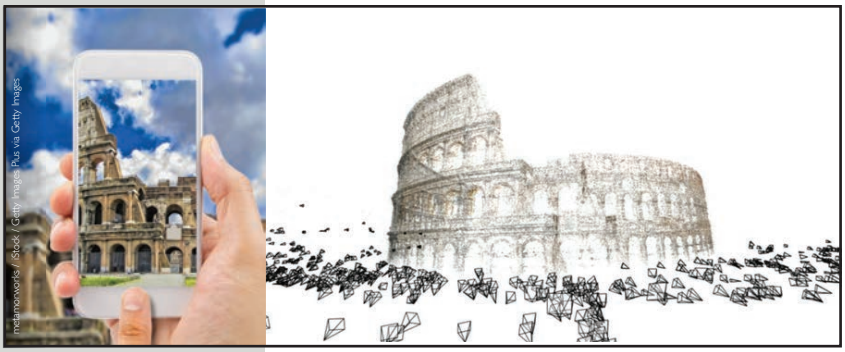
Bringing Photographs to Life



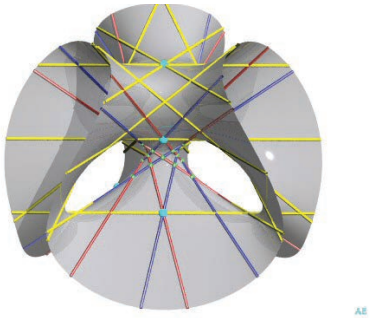
A 3D reconstruction of the Colosseum based on photos from Flickr.

Credit to Sameer Agarwal, Yasutaka Furukawa, Noah Snavely, Ian Simon, Steve Seitz, and Richard Szeliski. *Building Rome in a Day*, https://grail.cs.washington.edu/rome/.

Picture this. Your best friend just returned from a whirlwind vacation to Rome. She's showing you photo after photo of the Colosseum, the famed ancient Roman amphitheater. As you look through her pictures, you wonder: Are these 2D photos really giving you a good sense of the 3D Colosseum?

It turns out you're getting more information than you might think. Tools that build 3D models out of 2D photos are all around us. They blur our Zoom background when we're embarrassed by the mess behind us, and they make the special effects in our favorite movies possible. In fact, in 2009, a team from the University of Washington, Cornell University, and Microsoft Research used images uploaded to Flickr by tourists like your friend to create a 3D model of the Colosseum,as well as other attractions in Venice, Italy; and Dubrovnik, Croatia.

The mathematics of image reconstruction is both simpler and more abstract than it seems. To reconstruct a 3D model based on photographic data, researchers and algorithms must solve a set of polynomial equations. Some solutions to these equations work mathematically, but correspond to an unrealistic scenario — for instance, a camera that took a photo backwards. Additional constraints help ensure this doesn't happen. Researchers are now investigating the mathematical structures underlying image reconstruction, and stumbling over unexpected links with geometry and algebra.



A team of mathematicians found that this shape, which has been studied for centuries, has close ties to an image reconstruction algorithm.

Credit to Alain Esculier, mathcurve.com.

References:

Sameer Agarwal, Yasutaka Furukawa, Noah Snavely, Ian Simon, Steve Seitz, and Richard Szeliski. *Building Rome in a Day*, https://grail.cs.washington.edu/rome/.

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Joe Kileel, Kathlén Kohn. *Snapshot of Algebraic Vision*, https://arxiv.org/pdf/2210.11443.pdf.

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