How to Photograph the Power of a Punch

: using polarized light to analyze the dynamics of karate punch.

by
Ted Kinsman
Assistant Professor
Department of Photographic Sciences
Rochester Institute of Technology
January 12, 2017

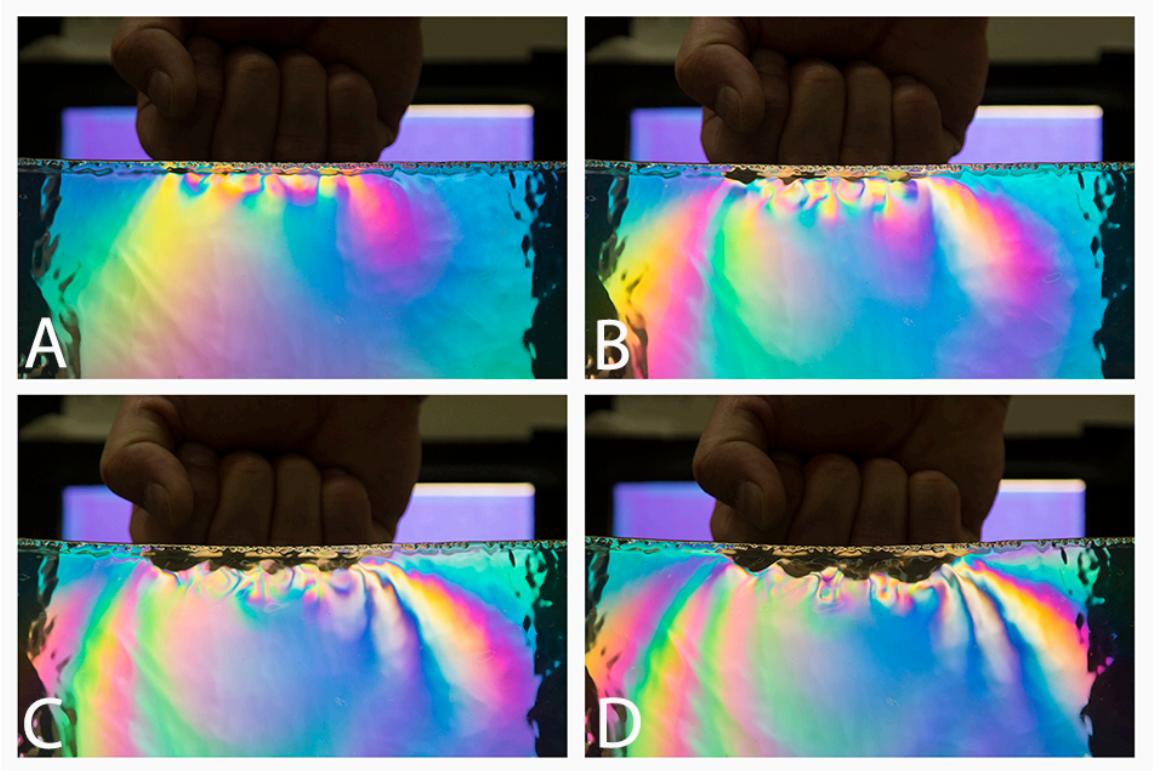
Many materials show internal stress when illuminated with polarized light and photographed with a second analyzing polarizer. This unique property of materials is called birefringence. Some of the more common material that exhibits this property is glass, ice, and most plastics.

To visualize the pressure created by a professional karate punch, I used a block of clear ballistics gel obtained from the sources listed below. The size of the clear ballistics gel is 6 by 6 inches and 16 inches long. The gelatin is calibrated to meet the USA FBI protocol for ballistic testing. I realized that I had to photograph a professional punching the block. Aric Keyes, a local professional Karate teacher known for his skill in the sport, volunteered his services.

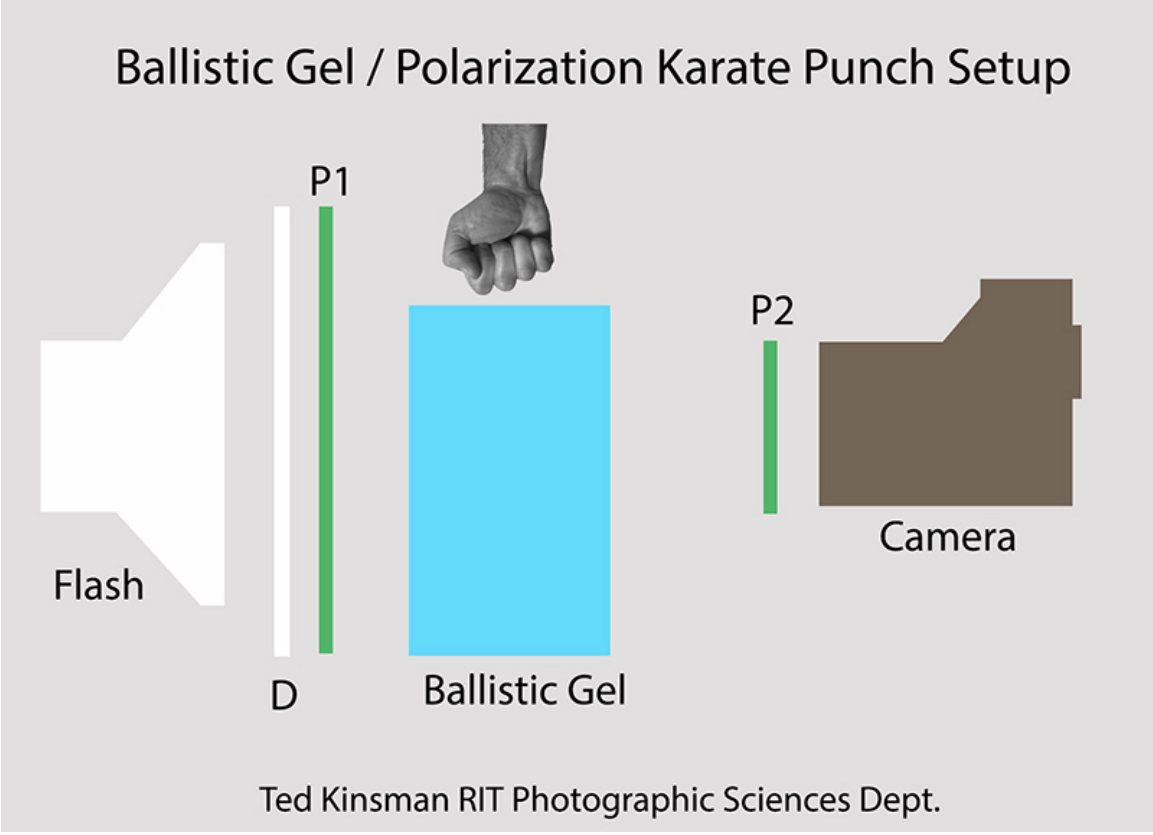
To photograph the ballistic gel, the block was illumined by an Einstein flash operating at $1/64^{th}$ power. There is a sheet of plastic tracing paper placed on the flash side of the polarizing film that acts as a diffuser. The block of ballistics gel is smoothed with a heat gun to make it optically clear. A second polarizer is placed over the lens of the camera to be the analyzing polarizer. Without the analyzer on the camera, you would not be able to observe the birefringence can. I like to think of these systems as a polarizing sandwich where the meat is the object showing the stress, while the bread represents the polarizers.

To record the high-speed action, I used a Mumford time machine to trigger the flash at exactly the correct time. A microphone taped to the ballistic gel detected the punch. The system worked surprisingly well and I was able to see the unique stress patterns in the ballistic gel produced by of different punches.

Special thanks to Aric Keyes of www.kime-karate.com who systemically hit the block of ballistic gel time and time again.

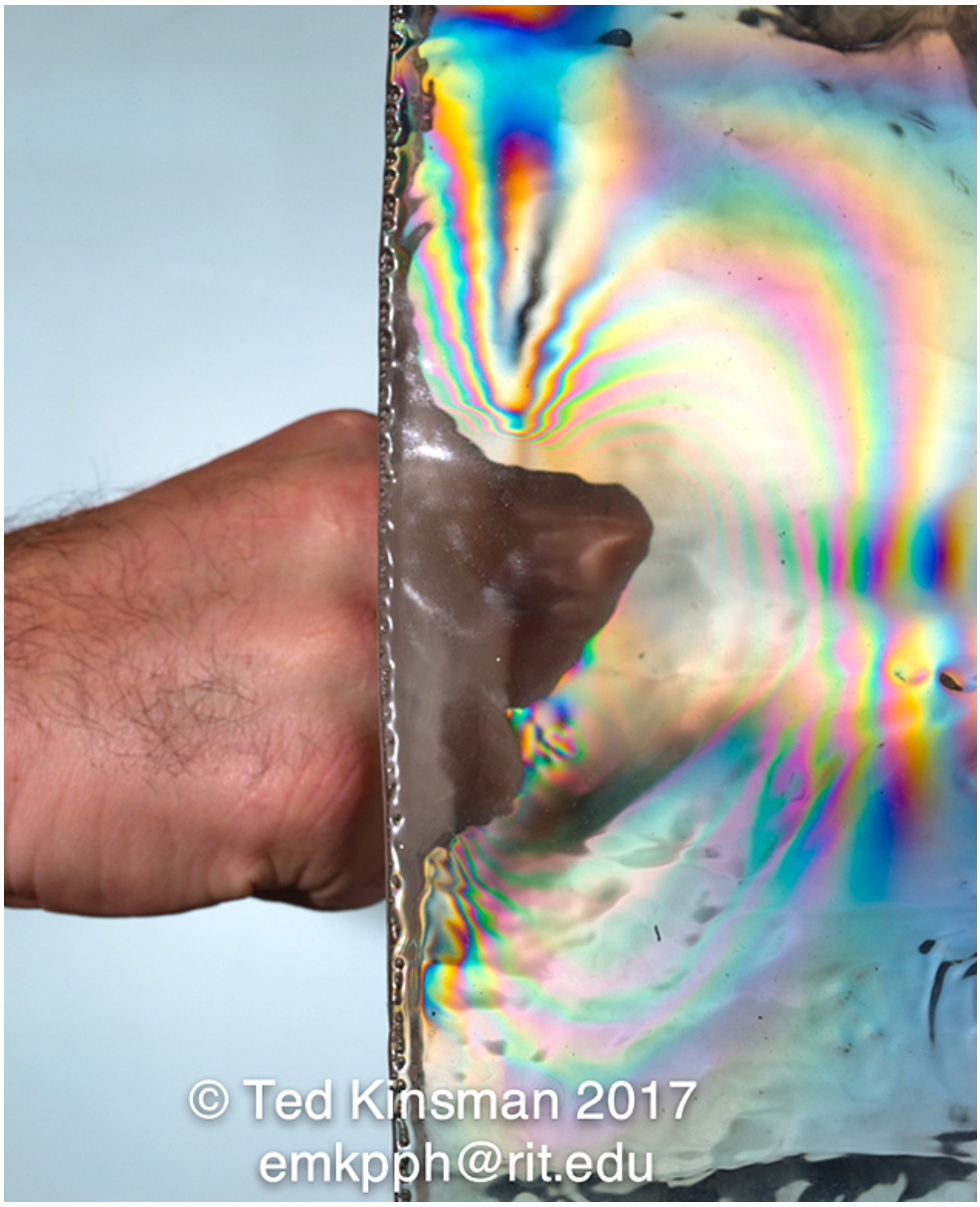


A sequence of four punches shown at different timings.



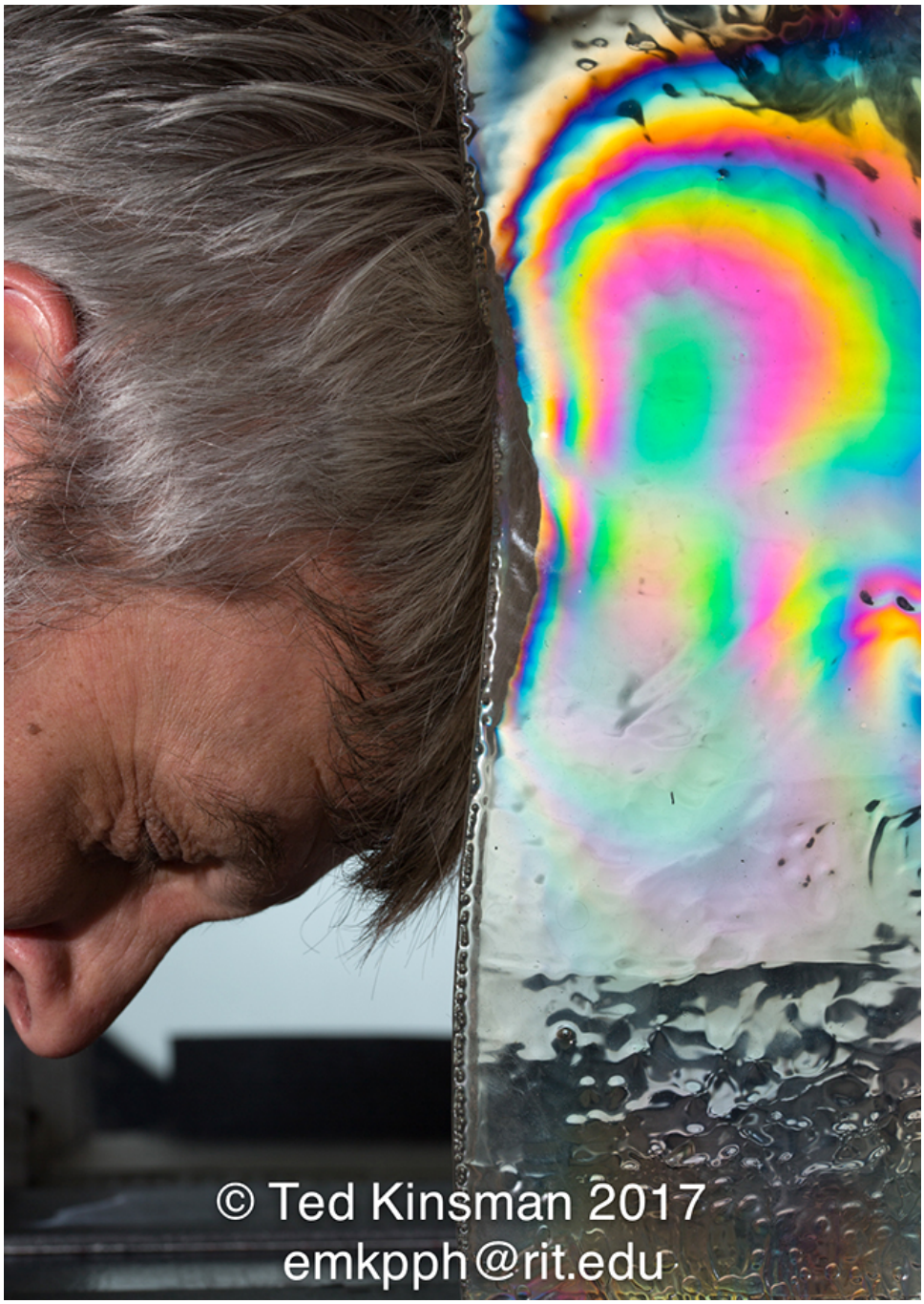
Equipment setup. D is a diffuser, P1 is the first polarizing sheet, P2 is the analyzing polarizer and on the far right is the camera.

A professional karate punch. Note the even distribution of force through the block of ballistic gel that simulated human tissue. Preformed by Aric Keyes.



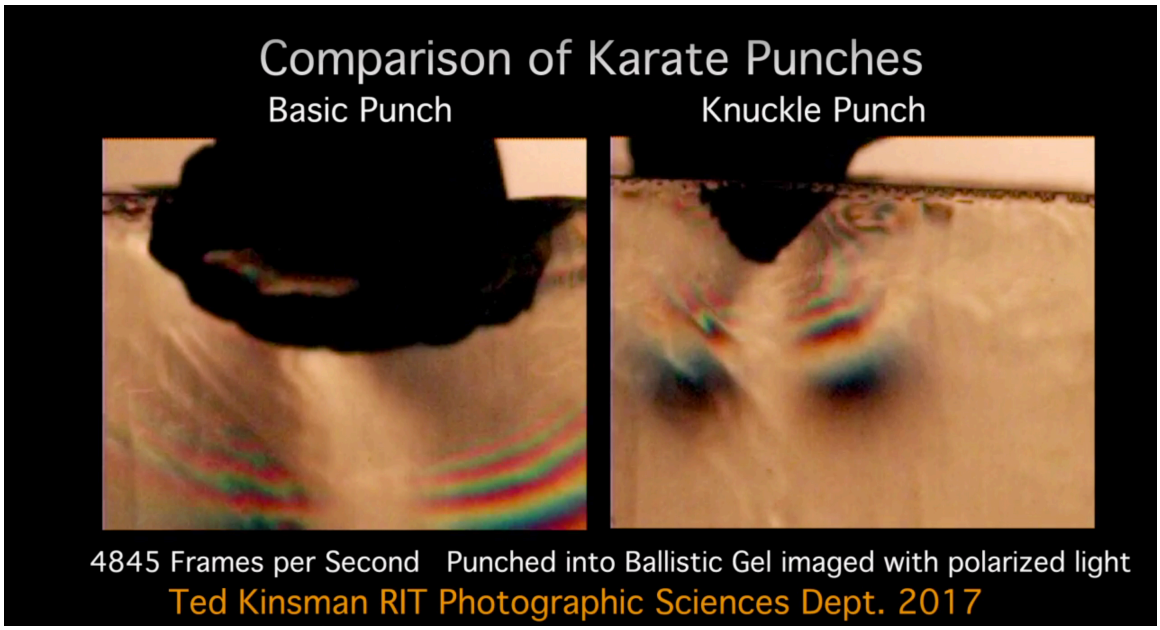
A professional karate knuckle punch. Note the distribution of force is much different from the punch shown above. Preformed by Aric Keyes.

An example of a punch performed by an untrained individual. The uneven angle of the knuckles shows the uneven pressure in the contact area. The use of ballistic gel is an excellent technique for visualizing proper punching technique.



A head butt performed by the author. This type of defensive blow is known for doing equal damage to each of the participants.

A high-speed video recorded with an Edgertronic high-speed video camera can be found at:



https://youtu.be/uzYmHuQxees

Sources:

Clear Ballistics Gel
https://www.clearballistics.com/

Polarizing Sheet
Rosco Polarizing #7300 Filter - 17x20" Sheet
http://www.bhphotovideo.com

Einstein Flash E640
https://www.paulcbuff.com

Mumford Time-Machine Camera Controller
http://www.bmumford.com/photo/camctlr.html