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Flow Visualization 4200



Wet Web

This photo was submitted for our third team project. I was not able to join my group for this project so decided to use a photo I had taken earlier in the week. I went hiking and on the way back from my journey, it began to rain very hard. I was worried that I would slip on the trail due to the wet conditions so I decided to put all my camera gear in my backpack and walk back as quickly as I could. Suddenly, in the corner of my eye, I noticed what looked like a giant splash of water

suspended in the air. When I stopped to look more carefully, I realized it was a spider web which collected all the rain that fell on it. It was mesmerizing so I decided to get my camera out and take a few shots.

Here is an interesting article I found on BBC about the flow phenomena of the jewels of water that form on spider webs: <http://news.bbc.co.uk/2/hi/8496559.stm>

Lei Jiang, the scientist from the Chinese Academy of Sciences in Beijing, who led the research, explained how he came to study this aspect of spider silk.

"Bright pearl-like water drops hang on thin spider silk in the morning after a fog," he said.



Up close, spider silk fibres are composed of "puffs" and "joints" Dr Lei explained that these large drops gathered on the "knots" in a spider's web.

"The spider silk can be several tens of micrometres in diameter, [whereas the water drops] can be thousands of micrometres wide," he added.

Using a powerful electron microscope to study the spider silk, his team discovered that the silk transformed when it was wet.

At the nanoscale, spindles of spider silk are formed from "puffs" of extremely tiny fibres, or nanofibrils, connected by joints.

But when the web is in a damp, foggy atmosphere, these nanofibrils shrink, causing the bumpy silk fibres to smooth out.

This physically drives the water towards the relatively rough and bumpy knots in the spindle, where it gathers into large droplets.

Dr Randolph Lewis, a molecular biologist from the University of Wyoming, US, who studies spider silk said: "The most interesting feature of this study is that the effect is totally due to the fibres themselves."

To capture this wet web, I tried shooting it at multiple angles. First I tried shooting it from above since it was low to the ground. I liked the image but it didn't capture the suspended look that originally got my attention. I bent down on the ground (even though it was wet and muddy) and captured the image below. There was plenty of sunlight even though it was still overcast



from the storm so I did not use any additional lighting.

The photo was captured using my Canon 5d Mark ii with a 24-105mm telephoto lens. I zoomed in to 105mm capturing 0.5 ft field of view with the lens ~1.5 ft from the web. The image size is 5616 X 3744 pixels. When processing this image, I decided to raise the exposure and contrast, making the colors more vibrant and the web lighter while the background darker. I think it made the photo much more dramatic. I considered cropping the image around the web so it was the only thing that was visible but I decided lines and colors of the grass and twigs really complemented the form of the web and gave some environmental context to the viewer. There were a few rain drops on the twigs which I darkened, specifically the drop on the top right shown above. I thought they were distracting from the web so I removed them. Other than those changes, I think the image really shines for itself. I used an aperture of 4.0 to capture the natural light, ISO 100, and shutter speed of 1/125. In hindsight, I would have used a smaller aperture to get information on more of the drops like the very bottom one but I also like the short depth of field in the photo.

Overall, I was very awestruck when I saw this wet web and am happy that I was able to visualize it in some way. I think that the article explaining what was happening at the nanoscale when these intricate spider webs get moist was fascinating. I never really paid attention to the flow phenomena until now and am very interested in finding more wet webs in the future!