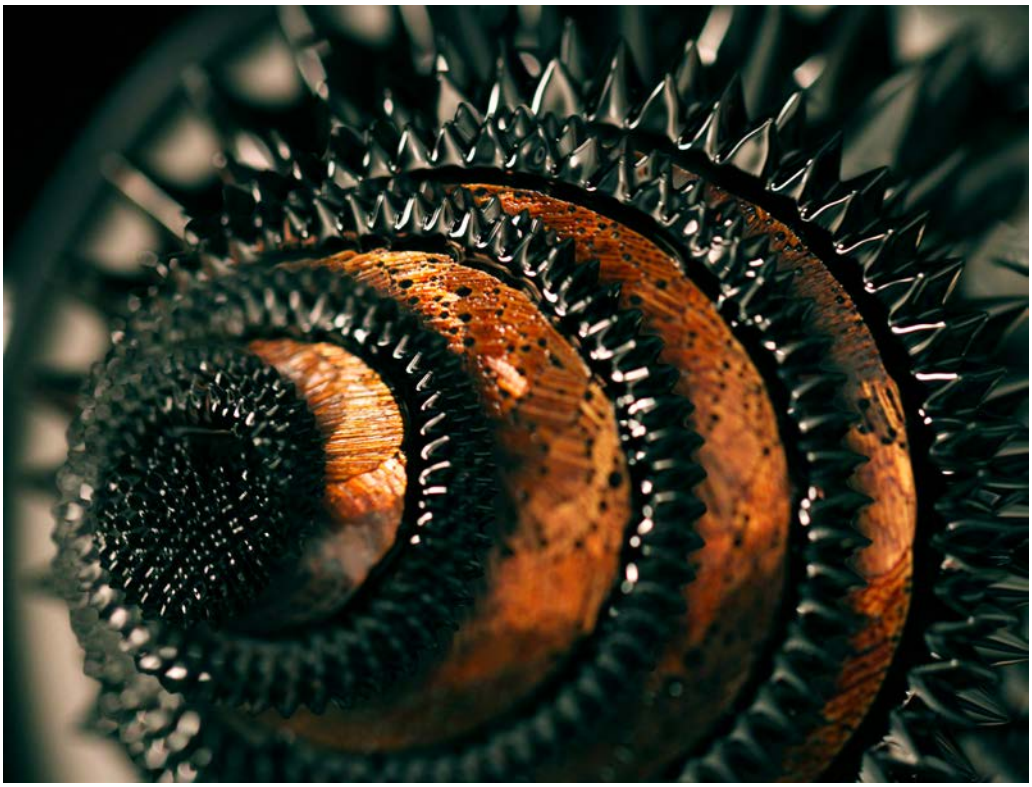
Peter Davis
Group Assignment 1
Flow Visualization



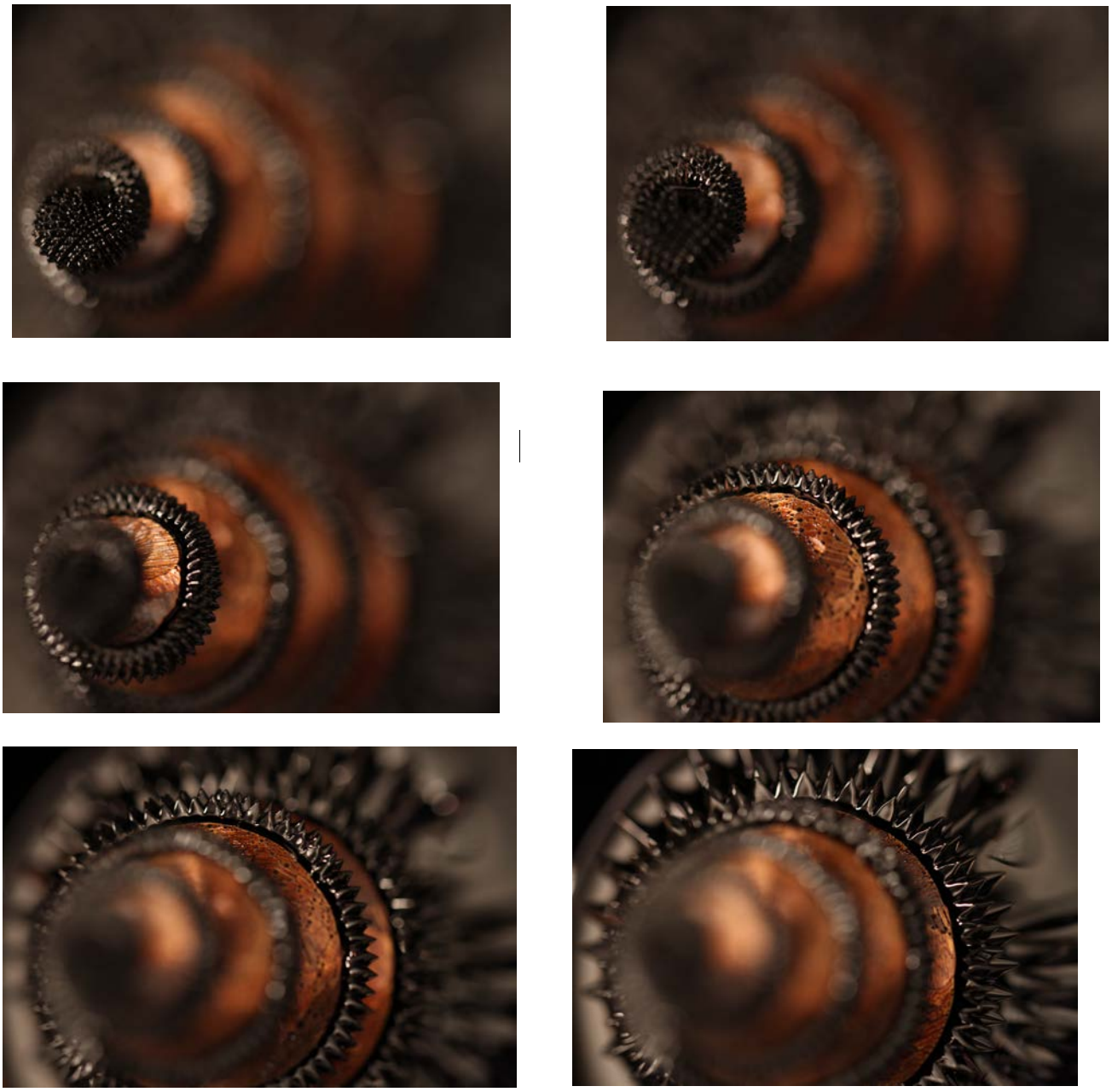
This picture was taken with a group for the first team assignment. I am making three ferrofluid exhibits for my senior project, and the group thought we could get some good pictures from them. Ferrofluid is special because it demonstrates properties of both fluids and magnetic fields in a very visually striking way. No other fluids behave like ferrofluids do.

My image shows one of the ferrofluid exhibits. A dish of ferrofluid sits on top of an electromagnet. A spiral shaped steel sculpture sits in the dish directly above the electromagnet. A current of about 10 A flows through the electromagnet, creating a magnetic field that goes up through the spiral sculpture. The magnetic field lines prefer to travel through the conductive steel over the surrounding air, and so they stay in the steel as long as possible. The field lines exit the sculpture through points more than through the curved surface. Therefore, the magnetic flux is greatest along the edge of the spiral. The concentrated magnetic field along the edge pulls the ferrofluid out of the dish. The ferrofluid forms spikes for a similar reason in an effect called normal field instability. The magnetic field prefers to travel through the ferrofluid than the surrounding air, and so long spikes are the favored, lower energy state for the system. The size of the spikes is limited by the surface tension of the fluid. The surface tension pulls the fluid back in, trying to limit the overall surface area of the fluid. The ferrofluid spikes that result are the balance between the magnetic field pushing the fluid out into large spikes, and the surface tension pulling it back into small ones.

The picture was taken in a dark room with a single, bright light source. This lighting was chosen to give the ferrofluid as much depth as possible. Each spike gets a nice looking glint of light shining off of it. The light source was shining onto the spiral sculpture from the side. The picture was taken looking straight down at the sculpture from above.

The image was taken using a digital Canon SLR. The room was completely dark other than the one light source, so a large aperture (3.2) and slow shudder speed (1/10) were used. The camera was

mounted on a tripod to avoid motion blur. The large aperture only allowed a small portion of the sculpture to be in focus. We tried taking a couple pictures with a smaller aperture and a very long shudder speed (20 seconds). These pictures captured the entire sculpture in focus, but small movements in the ferrofluid made the picture blurry. Instead I used photoshop to edit together five different pictures which each focused on a different part of the sculpture. This created a single image of the entire sculpture in focus.



I think this image is an excellent portrayal of ferrofluid properties and the exhibit I made. I like the top view perspective, as it shows the ferrofluid spikes very well, and from an angle not normally seen when looking at the exhibit. The stitching together of multiple photographs definitely had its drawbacks. There are spots throughout the picture which are out of focus, creating an unusual effect where there is not a single focal distance. The borders between the different layers where I edited pictures together have little flaws too if you look closely. A single picture in which the entire sculpture

was in focus would have been better. However, the process was a great lesson in photoshop for me, and I like my final picture better than the small aperture picture we had tried to take.