Guy Casavan

4/9/12

FILM 4200

Group 2 Image Report

This was the second group project for the Flow Visualization course. For this project, our group decided to capture images of a granular flow by using a shaker table located in the ITLL that had sand on it.

The apparatus used in this project was a circular shaker table approx. 2.5 ft. in diameter. The table had walls to keep all the sand inside, due to the fact that the focus of the motion was in the center of the table, and flows from the sand propagated outwards towards the edges of the table. The shaker table vibrated in a horizontal motion which varied in intensity depending on the users manipulation of a knob which increased and decreased intensity. The resulting flow that was captured is that of many small bumps that form and then propagate towards the sides of the table, where a larger pile of sand can be seen in the background. These bumps were all relatively evenly spaced from each other and of approximately even height (~5mm). This flow did not occur in such a distinct fashion if the sand was too dense over the center of the shaker table, so prior to inducing the vibration, the sand was smoothed out into a relatively flat layer about 2.5mm thick (roughly half of the height of the bumps that occurred thereafter). One could notice how the flow took on shapes based on pre-existing incongruences in the flatness of the static layer of sand, so these bumps came from a very flat, evenly distributed layer of sand; if ridges occurred in the static layer, then the ridges would build upon themselves instead of evenly distributing sand into conical piles. I found in my research on this flow that the reason that piles of sand are formed is due to the inter-granular contact friction created when the sand is forced to move. The larger grains have more friction imposed upon them because they have a larger surface area, and thus move less (i.e. staying at the bottom of the piles and building a foundation). The smaller grains have less friction due to their smaller surface area, and thus move more (i.e. jumping to the tops of the piles). The grains of sand then become roughly sorted according to their size and find their places in the piles based on their ability to move. (Tennakoon et al., 472-474) When one looked at the piles in motion, it could be seen that the grains on the bottom didn't move very much (except to transport the piles), but the grains on top were jumping off of the surface and into the air. However, I was not able to find adequate documentation describing why the piles themselves moved outward. I suspect that this is because the piles are trying to escape the motion and move towards areas of the table which allow them to achieve stasis, or that perhaps the table is not completely flat, but lower on the sides (however, in the experiments done in the research, this motion outward occurred as well in perfectly level tables, so this is unlikely to be the cause, although I know that the table I used for my experiment was not perfectly level), although this is just conjecture and not scientifically proven.

In order to visualize this technique, we used 2 strong tungsten lamps to illuminate the bed of sand. Both lamps were set on the same side and aimed at the bed at approximately 30 degrees below horizontal, so that a shadow was created on the backsides of the piles and ridges being observed. This was done in order to give the flow more feel and three-dimensionality, and to have the piles stand out more from the surrounding bed of sand.

The size of the field of view in the photograph is ~5 in. across x ~2.5 in. high. The distance from object to lens is about 3 in. I wanted to get the camera as close to the flow as possible so that the small grains of sand could be best visualized at a macro level, and to elevate detail in the image. The image was shot at 200 ISO, at f10, and at a shutter speed of 1/160 sec. I chose to lower the shutter speed because the grains of sand were not moving too fast, and didn't need to be frozen at a higher speed, so this let me lower the ISO to get better detail in the picture and reduce graininess (no pun intended), and also to open up the f-stop as high as I could. I wanted to open up the f-stop as high as possible so that I could achieve a really shallow depth of field. I felt that this shallow depth of field accentuated the details in the sand piles, and helped to give the viewer an area to focus on, rather than have too much to look at. It also makes them look bigger than they actually are, enhancing the effect macro effect. The lens focal length was 50mm., and the camera used was a Canon Rebel XS. The original image was 3888 x 2592 px., but was cropped to 3750 x 1860 px. because the focus of the image was in the center, and I felt that only part of the top and bottom were necessary in order to draw the viewers eye in. Also, with the top and bottom truncated, it makes the piles of sand in the photo look larger than they actually are. I processed this photo in Photoshop by heightening contrast (to draw the piles out from the background) and I changed the color temperature, because the original photo was orange due to the tungsten lights, and I wanted the sand to look natural. I also heightened the vibrance because it brought out some of the sparkling in the grains of sand.

Overall I am very happy with my image. I like the shallow depth of field, although I understand from the feedback that it is not everyone's cup of tea. However, while some commented that they didn't like the blurriness in the top and bottom, almost everyone liked that the piles of sand looked a lot bigger than they actually were, and I don't think they consciously realized that the shallow depth of field greatly contributed to this effect. I think that once explained, this photo shows a lot about the fluid physics of the granular flow, but it is evident that to me that if unexplained this may just look like piles of sand, so I am a little disappointed, and this is definitely something I would like to improve on. I think that this flow could have been better demonstrated using video, but I am trying to expand my knowledge of still photography and I prefer to try to exemplify flow motion through still photography because it is more challenging, and really any flow could be better visualized with video. Maybe something I could have done was used a series of images side by side to show the progression of motion, but then the details of the photo do not get as much attention. I would also like to find some more advanced research on how granular flows work, because it seems that this subject is still largely unexplored and its causes still remain somewhat unknown.

Works Cited

- Tennakoon, S. G. K., L. Kondic, and R. P. Behringer. "Onset of flow in a Horizontally Vibrated Granular Bed: Convection by Horizontal Shearing." *Europhysics Letters* 45.4 (1999): 470-75. Web. <https://docs.google.com/viewer?a=v&q=cache:3Lt2uUMC5osJ:cams.njit.edu/~kondic/granular/EPL_granular99.pdf+&hl=en&gl=us&pid=bl&srcid=ADGEESif8bEv7wBBEBGs5QePP6gzo1p8e7kUra-AvA0O3sNFJX3uO4Ciqt_YjoggyxpXp9wFrcZulYuOdQVJyo7Xk48zZ0wYKwBApqfFCIA9qUUKroFyvXVL95Y9MrewCtZho5s_w_WM&sig=AHIEtbTYzkppL04WE7xc1zKIYcdNdarlZQ>.