

## Natural Hair Movement

One of the hardest problems facing the field of interactive computer graphics today is the natural movement of liquids. An ocean as a whole is difficult to model because of the way the movement of one water molecule affects the movement of another and thus the ocean as a whole. The same problem is present in modeling the movement of hair on a computer. A head of human hair is difficult due to the nature of a strand of hair and how the movement of one strand affects the movement of others on the head. The topic of liquid movement in graphics has been researched for a long period of time while the movement of natural hair has just recently begun to be examined. However, a couple papers have been released that outline different methods in the hopes of finding a method that can be used to accurately simulate a head of human hair as it moves.

One method for simulating the movement of hair is done by using a set of particles which then reference the head of hair as a whole. These particles are then used to display how the head of hair moves during certain interactions as opposed to another common method that deals with strands of hair moving and interacting with each other. The difference in the particle method verses the one with strands can be seen in Figure 1.

The problem with this method is that hair strands can act independently of one another and this method only concerns itself with the look

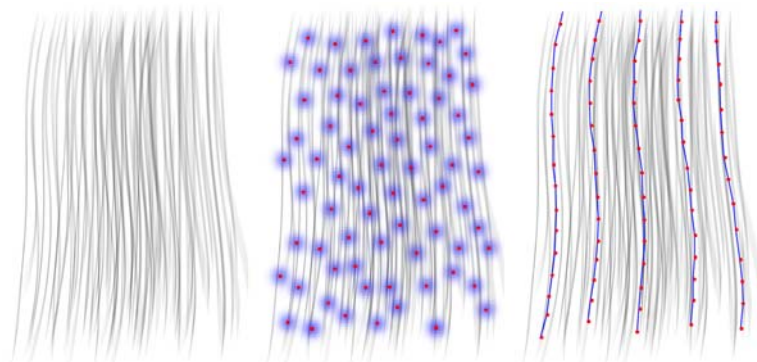


Figure 1

of the hair as a whole, not necessarily how the individual strands of hair move. This discontinuity can be seen in Figure 2. The head is being shaken side to side in these frames and the movement of the hair does not look natural. When looking at the bottom right, the right side of the hair does not move, meaning that the head as a whole appears to be shaken back and forth but when examined on parts, the right side does not appear to follow the shaking motion. While this method would look correct for



Figure 2

characters in a computer game that are not the focus or center of attention, it would appear as if the hair was moving correctly given that people are not focusing their attention on that character. However, if this method was used for a main character then the player of the game would notice that the hair just does not appear completely natural.

Another method that has been proposed in this field was put in a paper titled “Super-Helices for Predicting the Dynamics of Natural Hair” which was released in 2006 describing a method for mimicking the movement of natural hair in computer graphics. In this a method the hair is simulated focusing on individual strands of hair using super-helices which allows the simulated hair to bend and twist very similarly to natural hair. These super helices are comprised of sections of helical elements which move in different ways depending on the movement of the other helical elements on the strand. Each

super-helix is made to simulate a chunk of hair to save on computing time due to the overhead that would be needed for individual strands of hair. When these super helices are put together, they allow the hair to appear more natural in movement. The same side to side movement as before can be seen in Figure 3. This time it is placed next to an actual person moving her head and the simulated hair appears to move in a similar fashion. The hairs move independently of each other and the sections of the hair all appear to be moved by the back and forth motion of the head.



Figure 3

Another interesting point was made in the article about super-helices. It is about the nature of human hair. Each person's hair is different in its composure and the way it moves. The group that wrote this article was able to categorize the type of hair into three different types: straight, curly, and fuzzy. Based on these different types of hair they were able to simulate hair for different types of people and especially for the curly can simulate the effect of a curl bouncing on a person's head as seen in Figure 4. This will allow games to better model a person in the game and allow the players to feel more



Figure 4

immersed in the game. Further the different types of hair that can be simulated will allow for a variety of characters to be modeled without losing the look of the natural hair.

Overall, the field of natural hair movement in computer graphics is just on the tip of being researched, but many advances have been made. The first method allows for less computing to be done with still generally maintaining the look of natural hair movement. However, this second method mentioned which was just recently released has the potential to make hair modeled on computers look more realistic which in turn could have a big impact on the computer game industry.

#### References:

“Super-Helices for Predicting the Dynamics of Natural Hair” by Florence Bertails, Basile Audoly, Marie-Paule Cani, Bernard Querleux, Frederic Leroy, and Jean-Luc L´eveque  
<http://www-evasion.imag.fr/Publications/2006/BACQLL06/>

“Animating Hair with Loosely Connected Particles” by Yosuke Bando, Bing-Yu Chen, and Tomoyuki Nishita  
<http://nis-lab.is.s.u-tokyo.ac.jp/~ybando/hair/>