Parameterization the Where and the How

Natural Lines

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The previous section mentioned the correlation between underlying muscles and the proper topology of a model. This section introduces two anatomical "phenomena" of the human body that help visualize the influence of the muscles on the skin: wrinkles and Langer's lines.

Wrinkles

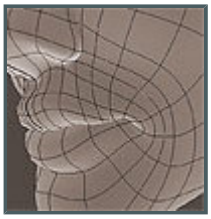
Wrinkles on skin are essentially the same as wrinkles on cloth: a bunching of fabric. The fabric draping the head, however, is typically firm and elastic, conforming tightly to the underlying fat, muscle and bone. Nevertheless, a large part of the expression and personality a particular head communicates is dependent on a network of temporary and permanent wrinkles.

Temporary wrinkles are those that that come and go with particular facial movement. Some of these wrinkles are key to identifying facial expressions. The parameterization of a head model should plan for wrinkles that will be modeled into the blend (morph) shapes when setting up the head for animation.

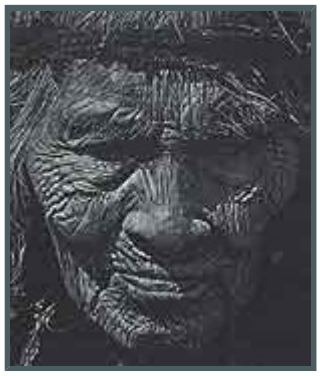
For Example

The most prominent of wrinkles, the smile/shout wrinkle around the mouth, is commonly overlooked in the modeling of youthful heads, because the crease is typically not visible in the expressionless base shape and the artist simply overlooks the fact that it will be needed later in modeling the target shapes (check out most head modeling tutorials on the web). Thoughtlessly extending the concentric circle parameterization of the mouth region, also contributes to improper structure for defining the mouth wrinkle. (I've been there and done that...)

rollover



Permanent wrinkles represent the history of a head's facial action, forming on the human face after a lifetime of facial movement (and time in the sun). As age increases, the elasticity of skin decreases. The skin becomes less and less able to spring back to its original position, increasing the surface area of the skin and eventually sagging and bunching on the face (more info). The lines formed by these wrinkles illustrate a nearly ideal topology for a CG head model.



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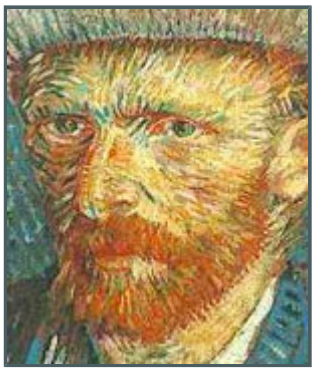


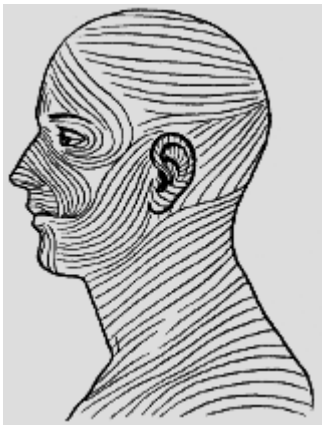
Self-Portrait with Grey Felt Hat

Van Gogh's intuitive understanding of the natural flow of lines on the face, possibly developed from observing the face's wrinkles of expression and age. The compatibility of Van Gogh's brushwork with Langer's Lines also leads one to wonder if he had been influenced by illustrations of these so-called *lines of tension*.

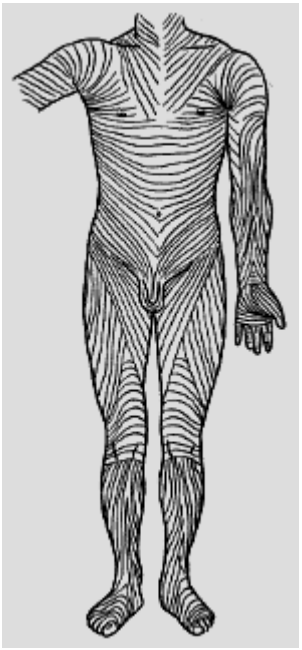
Langer's Lines

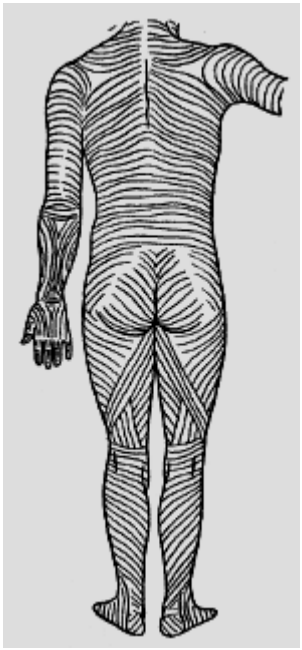
A stab wound inflicted with an ice pick or a similar weapon with a conical blade will leave a slit in the skin, not a round puncture as might be expected (a bit more info on stab wounds and Langer's Lines). The direction of a slit varies between different areas of the body but remains fairly consistent from person to person. Langer's lines map the direction of slits across the body and are used in surgery to guide incisions: cuts along Langer's Lines heal better leaving less scarring.

Named after Austrian anatomist, Carl Ritter von E. Langer (1819-1887), Langer's Lines represent lines of tension within the skin. These lines tend to be oriented parallel to the direction the skin is pulled and are dependent on the direction of collagenous bundles (elastic connective tissue) in the reticular layer of the skin.



Though certainly not the final word on topology, Langer's lines provide several interesting ideas for the head and rest of the body, as well as offer insights regarding the tension placed on skin in different regions.





Illustrations taken from
Henry Gray's *Anatomy of the Human Body*.
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theory overview *modeling theory* approaches
process setup NURBS polys/subds texturing animation
resources features close-up reference/links
gallery pics and movies

I invite all comments and criticism.