# Steroids: A Controllable Approach to Skin Simulation

Raffaele Fragapane Joseph Hegarty Aloys Baillet
Animal Logic*

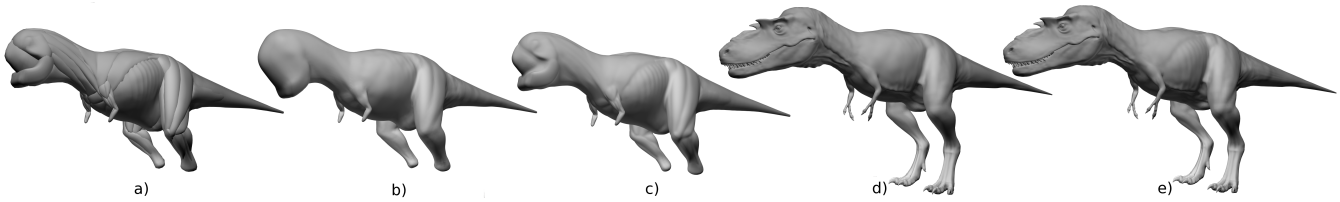


**Figure 1:** *a) Muscles b) Sock c) Deformed Sock d) Mesh e) Deformed Mesh.* *©20th Century Fox, BBC Worldwide. All rights reserved.*

## Abstract

*Steroids* is a time-independent, mass-spring and constraint based system for skin and fat simulation. Developed for *Walking With Dinosaurs 3D*, *Steroids* allows for scalable, iterative and controllable design of muscle based skin deformation.

## 1 Algorithm

We designed *Steroids* to enable concurrent work across asset departments. Rapid artistic design iterations were possible thanks to its use of time-independent solvers that required no precomputation. *Steroids* was designed with a separation of concerns for scalability and efficient use of computational resources. Our proprietary node-based, procedural animation and simulation system *ALF* was the engine for the Skin Simulation Algorithm.

*Steroids* had three separate components:

- Final Skin: high resolution subdivision surface with modelled-in detail (wrinkles, intramuscle striation) - 80,000 to 130,000 points.
- Sock: polygon mesh free of skin detail without head or fingers - 60,000 - 75000 points.
- The Muscles: subdivision meshes with volume preservation, jiggle, extension/contraction and manual override controls. 40,000 points.

*Steroids*' main responsibility, the sock, solves around the muscles using a multi-pass iterative mass-spring simulation that included the following steps:

- raycasting and collision with muscle geometry
- edge-length and angular conserving constraint [Nedel and Thalmann 1998]
- polygon shearing reduction

It supports per vertex pinning of areas of interest, and allows muscle ID binding isolation via sets, and simulation attributes per point via float vertex maps for complete and artist friendly control.

*{raffaelef,joeyh,aloysb}@al.com.au

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.
SIGGRAPH 2014, August 10 – 14, 2014, Vancouver, British Columbia, Canada.
2014 Copyright held by the Owner/Author.
ACM 978-1-4503-2960-6/14/08

## 2 Creature Design Process

*Steroids*, intended as the solver part of a set of compartmentalized systems, exceeded expectations to the point of becoming an important design tool. The design process stages were as follows:

- A flayed sculpt (a maquette stripped down to its muscles) was produced for internal review/approval, then approximated to a low res mesh and rigged traditionally for animators.
- Muscle meshes of arbitrary detail for "paleo approval" and deformation (Fig. 1a), and a concurrent stage for the relaxed sock mesh (Fig. 1b).
- The muscles were then procedurally attached to the control rigs by a set of hooks.
- Steroids was used to bind the sock to the muscles, regulate tension, tightness of the fascia, and frequency/intensity of striation (Fig. 1c). This enabled variation and iteration of the design within a species, allowing different proportions, gender and Body Mass Index to be created procedurally.
- A final mesh derived from the sock with added high frequency detail was bound to the sock's barycentric transform sets, allowing addition and local space control of elements such as wrinkles, intramuscular striation and facial animation (Fig. 1d-e).

## 3 Results

The skin and muscle designs were routinely changed and perfected with minimal or no effect on other departments. The time-free approach allowed TDs to work at any stage on rigs, poses or shots instantaneously. Geometry caching times were extremely short, rarely above 30s per frame. The same system and sock could be reissued and tweaked to completely different proportions, sizes and topology minimizing variation overhead. The entire final geometry output was an unprecedented 99.9% issue free, the AnimFX pipeline that was put in place was used almost exclusively to enhance creature effects. Overall, less than 10 skin simulations in the entire show actually required manual de-intersection.

## References

NEDEL, L., AND THALMANN, D. 1998. Real time muscle deformations using mass-spring systems. In *Computer Graphics International, 1998. Proceedings*, 156–165.