Terminator meets Simulator: CGI Tools used to drive a Virtual Product Evaluation

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Abstract: When computer generated imagery (CGI) first started to appear on movie and video game screens, the emphasis was to make something look close enough to its real counterpart to satisfy audiences. As graphics and computing capability progressed, audiences became less satisfied with "cartoon-like" animation; they demanded more realistic visuals. The entertainment industry reached across the aisle to the scientific community in attempt to incorporate more physical realism into animations. As a result, today's physics- based CGI can fool even a scrutinizing scientist into believing what he's seeing is real.

While the entertainment industry profited by collaborating with the scientific community, the benefit is mutual. For example, in order to study the fit performance of a dust mask with facial movement, we borrow a CGI technique to make simulation feasible. Specifically, the complex and intricate movements of the face are represented using a high resolution motion capture technique. Similarity between motion capture and finite element data forms allows their interchangeability.

In this study, detailed motion capture data of real facial movement was interpreted to produce a finite element model (node and element definitions) along with a time history of nodal displacements. The finite element data was stored as an Abaqus output database and subsequently used as a global model to drive a similar facial submodel to evaluate the fit and sealing performance of a pouch style face mask design under realistic use conditions. This paper outlines the analysis approach and shows results from the simulation.

Keywords: Abaqus, Submodel, c3d, Motion Capture, Moving Surface, Contact, CGI.

1. Introduction

This paper outlines an analysis approach used to evaluate the interaction between a man's face and a pouch style face mask used for respiratory protection (dust mask) that he is wearing. The process developed is, in general terms, a method of simulating a moving surface in a contact analysis. The specifics of the application are secondary to the methodology. At the time of this writing, the analysis for which this approach was developed is still in progress; therefore, details about the analysis are included only to illustrate the analysis methodology and show its advantage for special applications.

The methodology to be described involves using capabilities of Abaqus that likely were not developed with this purpose in mind. Specifically, a detailed set of position histories for hundreds of points on a face as it moves through various expressions and mouth open positions (e.g., a