

Study of a Diaper on a Moving Baby using ABAQUS

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Abstract: ABAQUS is used to simulate interactions of an absorbent personal care product (a diaper), with its user and their environment. This problem, being almost completely driven by complex contact between highly deformable and moving bodies, is a challenging proposition. Advanced contact algorithms, non-linear material models and multi-body dynamic analysis capabilities in ABAQUS are used to successfully study the structural interactions of a diaper, a baby and their environment. Aspects of product fit and comfort are often difficult to quantify either by direct measurement or from user feedback. However, by utilizing features of ABAQUS, it is possible to predict physical interactions that occur between the diaper and baby. ABAQUS provides predictions of contact interactions, stress profiles, and strain distributions that are otherwise not measurable. Based on these predictions, one can infer aspects of fit quality and comfort. Detailed predictions of stress, strain and contact within a product also provide a means to evaluate how well that product will be able to perform its intended function. Intimate absorbent personal care products, such as diapers, rely on a combination of containment, redistribution and capture of body waste to provide utility. The function of a diaper is dramatically affected and often driven by structural interactions between itself, its user and the surrounding environment. ABAQUS provides a means to study the response of a complex, multi-component diaper worn by a moving baby.

1. Background

Today's disposable diapers, while often taken for granted, are complex in design, consisting of multiple components and soft, thin materials. High quality fit and comfort are among the design goals for a product developer. Since the wearer of the product is a baby, direct design feedback regarding comfort is practically impossible to obtain. Developers must rely on observations and perceptions when evaluating the comfort and fit of a product on a baby. Additionally, a product designed to absorb body fluids can be significantly affected by local strain within the absorbent material. For these and other reasons, we desire to predict the deformation of, and contact interaction between, a virtual diaper and baby. The complexity of deformable, irregular geometries, non-linear and anisotropic materials in general contact makes this class of problem a challenge for even the most advanced finite element analysis software. Using ABAQUS, we have had success analyzing diaper deformation.