Winter, 2017

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DEFORM™ News

All training classes will be held at the SFTC office, 2545 Farmers Dr., Suite 200, Columbus, OH 43235.

Training:

- February 14-17, 2017: DEFORM training will be conducted at the SFTC office in Columbus, OH.
- April 18-21, 2017: DEFORM training will be conducted at the SFTC office in Columbus, OH.
- June 13-16, 2017: DEFORM training will be conducted at the SFTC office in Columbus, OH.

Events:

- April 4-6, 2017: SFTC will exhibit at Forge Fair in Cleveland, Ohio.
- May 7, 2017: SFTC will host the DEFORM Distributors Meeting in California. Details will be announced at a later date.
- May 8-9, 2017: SFTC will host the biannual DEFORM Users Group Meeting in California. Details will be announced at a later date.
- New for 2017: We will begin offering regular training webinars on special topics such as microstructure, elastic-plastic modeling, design of experiments, etc. Information will be posted on our website. Please watch your email for updates.

DEFORM™

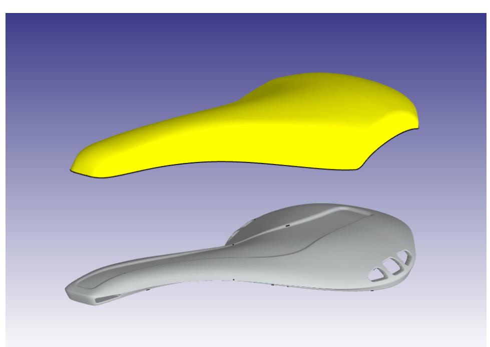
Design Environment for FORMing

Bicycle Saddle Design

Human tissue modeling has traditionally been the territory of general purpose finite element codes. General purpose codes are quite capable, but often sacrifice ease of use for flexibility. Mesh generation, non-linear contact analysis, and coupling of multi-physics processes can all be arduous. Recently, DEFORM was selected for its ease of use and flexibility in order to study the interaction of human tissue with the foam padding and underlying structure of a high performance bicycle saddle.

High performance bicycle saddle design is challenging. Saddles need to support high pressure and provide a firm link to the bike. Too much foam, comfortable for a recreational rider, means a “squishy” link and lack of control for a performance rider. Too little foam results in high pressure and discomfort. Excessive foam in the wrong areas can injure nerves and soft tissue. Balancing foam distribution becomes a critical exercise in saddle design.

Prototypes are expensive and objective measurements are difficult and invasive, even when a prototype is available. Evaluation of the foam padding design is an ideal application for finite element simulation.

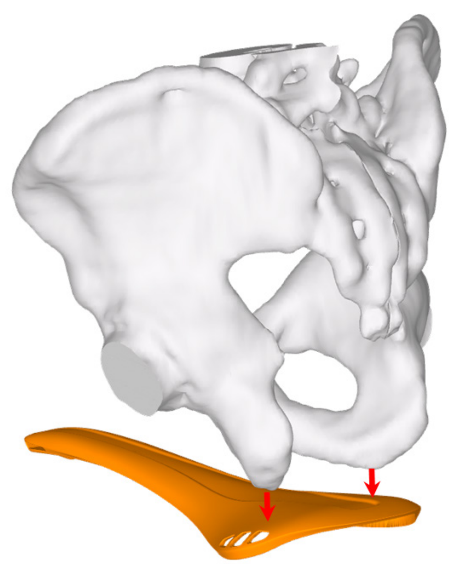


High performance bicycle saddles are made of a slightly flexible plastic shell (gray) covered with a high density closed cell foam padding (yellow).

The plastic shell provides direct support for the pelvic bones, while the padding minimizes pressure points. The design objective is to optimize foam distribution to provide adequate support while minimizing pressure on soft tissue.

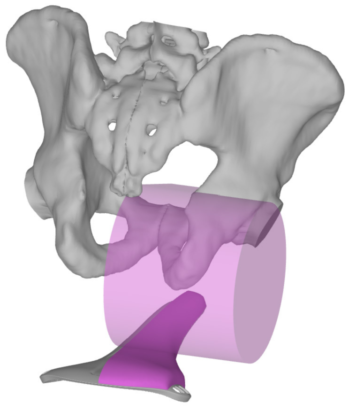
Finite Element Model Construction

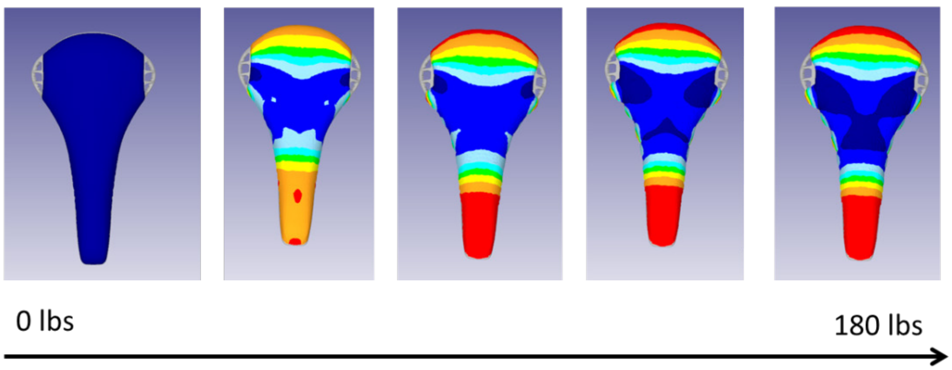
In this study, bicycle saddle shell and foam geometry were provided by Smanie Saddles.



An STL model of a adult male pelvic structure was obtained from the Biomedical Engineering department. Simplified human tissue geometry was created in Solidworks. The plastic shell and pelvis are substantially stiffer than the foam and human tissue, so both were treated as rigid. Foam and human tissue are visco-elastic, but for steady state loading, the time dependent viscous term can be neglected, so both materials were treated as linear elastic. The elastic modulus of foam is about 1MPa, and human tissue is about 0.06MPa.

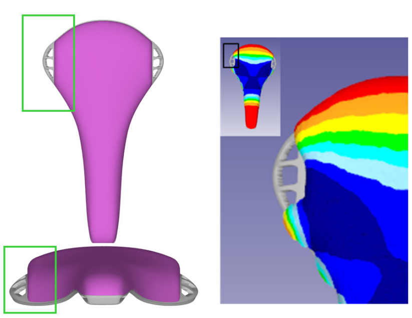
A Poisson's ratio of 0.3 was used. The materials undergo large deformation with possible rotation, therefore the DEFORM elastic-plastic material model was used. An arbitrarily large yield stress was specified, so the models remained perfectly elastic. The saddle in this study was designed for mountain biking, with the pelvis orientation selected appropriate for a relatively upright rider. Loading was assigned incrementally up to 800N, the equivalent of a 180 lb athlete. The unloaded condition is shown in the first picture below (on the left).

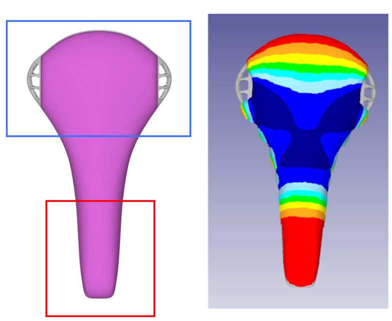




Analysis of pressure distributions with increasing load showed a pressure "hot spot" in the transition from the foam to the plastic wing. This region is highlighted in green in the left image below. A smoother transition is recommended in this area.

In the right image, high pressure is identified in the blue region, with lower pressure distribution in the red region. Variable thickness foam was recommended for these areas. 12-15mm was recommended for the rear of the saddle, tapering down to 10mm on the front. Based on recommendations, an improved design is being implemented and tested.





Conclusions

This DEFORM application involved highly nonlinear contact between multiple objects. The large deformation experienced by the objects required remeshing, which was seamlessly handled by the automatic mesh generator. Evolving, nonlinear contact was easily defined between bodies. The material models were robust enough to capture very soft materials. The project worked well, despite being outside the traditional metal forming application range for DEFORM.

Acknowledgements

Simulations were performed by Jennifer Malik, a Ph.D. candidate in Biomedical Engineering at The Ohio State University. Modeling was supported by Smanie Saddle Company and SFTC.

DEFORM V11.1 Service Pack 1

DEFORM V11.1 Service Pack 1 was released in December, 2016 and is available for download from the user area at www.deform.com. V11.1.1 includes significant enhancements for customers using the queue in a multi-user environment. A new queue interface allows the user to confirm the status of all jobs pending. It is now much easier to continue or clean up the queue after a power outage or network interruption.

A note on batch queue compatibility:

Due to these changes, the DEFORM version 11.1 SP1 batch queue system is not compatible with early versions of the queue system. Customers who use the queue system should plan to upgrade the license manager, simulation server, and all clients at the same time. Other improvements include enhancements to the operation editor in the multiple operations interface as well as improved performance of the 3D FEM solver. Complete details are available in the release notes, which can be downloaded with the service pack.

As always, if you have any questions, please contact your local distributor or DEFORM support staff.

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