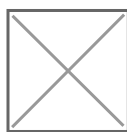


**Docket #:** S20-133

# **Real-time brain strain calculation and visualization using deep learning**

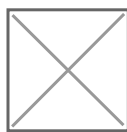
Stanford researchers at the Camarillo Lab have developed a neural-network based model that can provide real-time calculation of brain strain based on instrumented mouthguard kinematics signals. This fast and accurate calculation can help better protect athletes wearing the instrumented mouthguard disclosed in Stanford docket [S15-432](#).

Current approaches for head impact measurement such as finite element analysis (FEA) are much slower and do not use real-time models based on the complex dynamics of the head-brain interface to predict and visualize brain strain. This new neural-network model is dramatically faster, easier to interpret, and can calculate detailed spatial resolution of brain strain, showing metrics (maximum principal strain) in each of the elements of the brain.



**Figure description:**

Flowchart introduction of the model.



**Figure description:**

The visualization of the effectiveness and accuracy of the deep learning head model.

**Stage of Development**

- Prototype

# Applications

- **Mild traumatic brain injury (mTBI) diagnostics**
- Can be used by **Sports teams and Researchers**

# Advantages

- **Accurate and real-time calculation of brain strain calculation**
- **Fast calculation** - the new model is much faster (1s for one impact) compared to conventional FEA (hours for one impact)
- **Detailed spatial resolution of brain strain**, showing metrics (maximum principal strain strain) in each of the elements of the brain
- **Easy to interpret** - users without FEA experience can easily understand results

# Publications

- Zhan, Xianghao, Yuzhe Liu, Samuel J. Raymond, Hossein V. Alizadeh, August G. Domel, Olivier Gevaert, Michael Zeineh, Gerald Grant, and David B. Camarillo. Deep Learning Head Model for Real-time Estimation of Entire Brain Deformation in Concussion. arXiv preprint arXiv:2010.08527 (2020)

# Innovators

- Xianghao Zhan
- Yuzhe Liu
- David Camarillo
- Samuel Raymond

# Licensing Contact

**Evan Elder**

Senior Licensing Associate

[Email](#)