CEN/TC 158/WG 11
CEN/TC 158/WG 11 - Headforms and test methods
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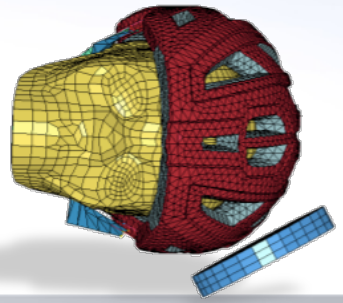
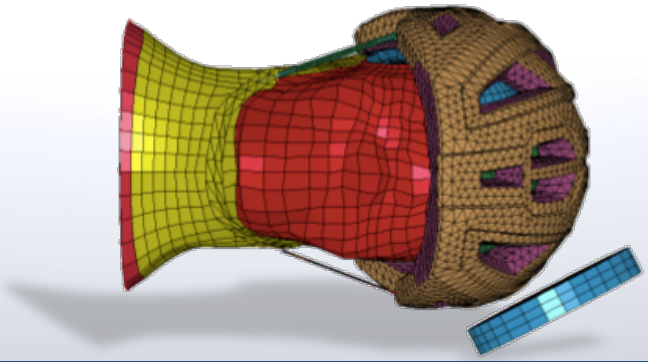


# CEN-TC 158 / WG11 meeting

## (Paris, 30th September, 1st October)

## UNISTRA ACTIVITY WITHIN WG11



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# PRESENTATION OVERVIEW

- Context
- Head injury mechanisms and SUFEHM presentation
- Effect of rotational acceleration
- Existing tests procedure
- Influence of the neck
- Discussion with Humanetics

# EFFECTS OF NECK

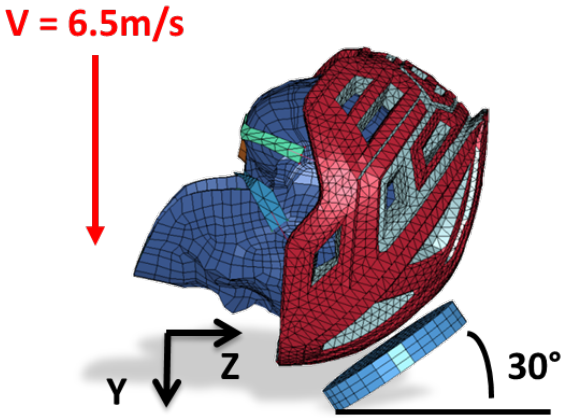


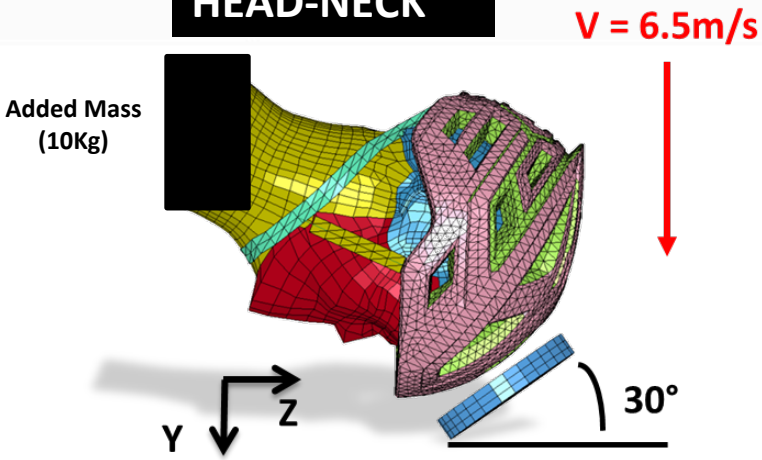
**Purpose** : Influence of the neck on Intracerebral response under Frontal & Lateral impact with a helmet protection

**HEAD ALONE**

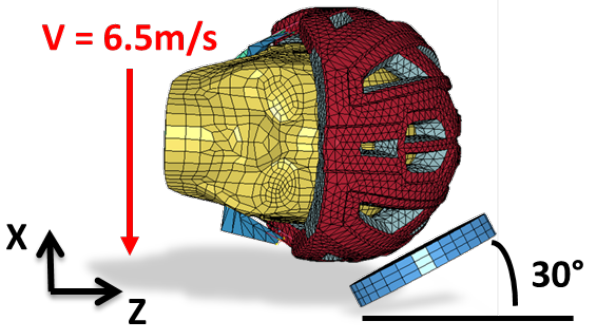
**HEAD-NECK**

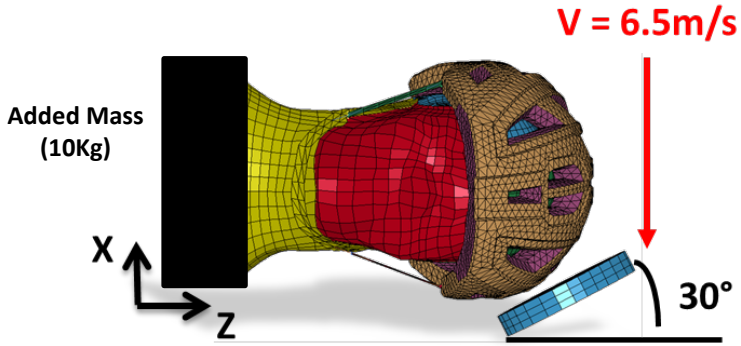
**FRONTAL**



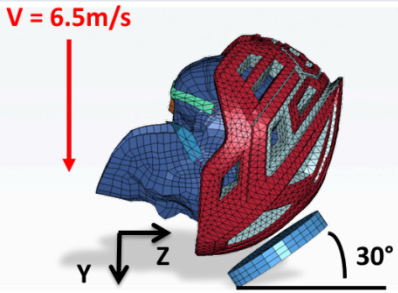



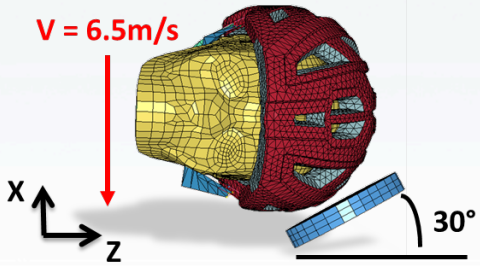

**LATERAL**



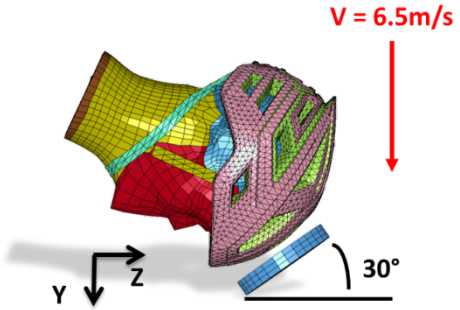



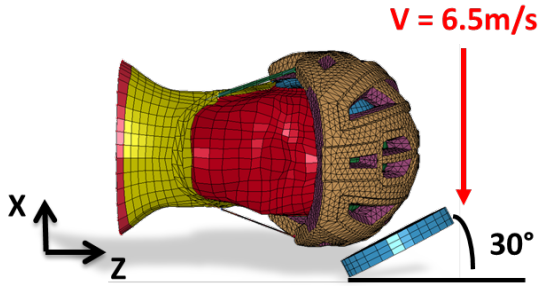
# CONCLUSION




| | Frontal | Lateral |
|---|---|---|
| **Head** | Von Mises Stress = **31** Kpa<br>*HIC= 758* | Von Mises Stress = **38** Kpa<br>*HIC=971* |
| **Head-Neck** | Von Mises Stress = **64** Kpa<br>*HIC=1616* | Von Mises Stress = **51.5** Kpa<br>*HIC=918* |



# HEADFORM DEFINITION

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## Critical issue

Rigid Mass

## Comments

The value of the mass includes “some” neck effects and its inertia is not controlled

## Recommandations

Replacing ISO headforms by Hybrid III head

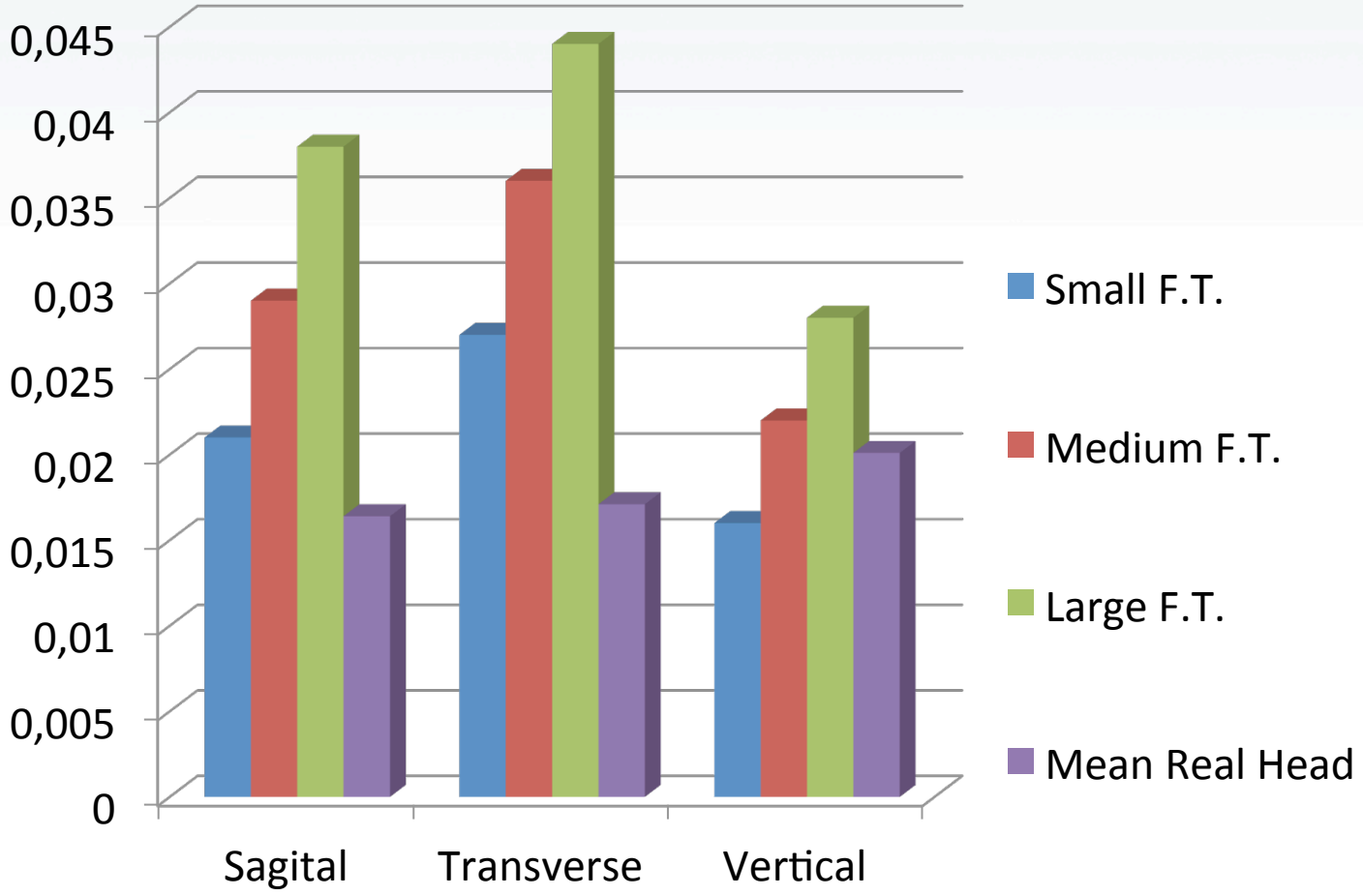
- More realistic head mass
- More realistic head inertia
- Deformable skin
- Easy link to Hybrid III neck
- Possibility to fix rotational transducers

| | Mass [kg] | $I_{xx}$ [kg.m²] | $I_{yy}$ [kg.m²] | $I_{zz}$ [kg.m²] |
|---|---|---|---|---|
| ISO Pedestrian | 4.5 | $11.10^{-3}$ | $11.10^{-3}$ | $110.5.10^{-3}$ |
| **Hybrid III 50th** | **4.5** | **$17.088.10^{-3}$** | **$18.872.10^{-3}$** | **$22.685.10^{-3}$** |
| **SUFEHM** | **4.5** | **$17.996.10^{-3}$** | **$18.360.10^{-3}$** | **$21.902.10^{-3}$** |
| ISO motor M | 5.7 | | Not controlled | |

The A, C, E, J, M and O sizes represent 95% of size used in global standards.

| EN 960 headform size | Head circumference [mm] | Dummy model | Head circumference [mm] |
|---|---|---|---|
| A | 500 | Hybrid III 3 Year Old | 508 |
| C | 520 | Hybrid III 6 Year Old | 520.7 |
| E | 540 | Hybrid III 10 Year or 5th Female | 538.5 |
| J | 570 | Hybrid III 95th Large Male | 584 |
| M | 600 | Hybrid III 50th Male | 597 |
| O | 620 | | |

# ISO HEADFORM INERTIAL PROPERTIES



# DISCUSSION WITH HUMANETICS

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Q1) Is there a standard or an official certification method for this head ? Yes. Head drop tests on rigid plate from 376 mm height impacting on the forehead. Total head mass including instrumentation (three accelerometers) 4.54 kg. The test is such that only limited rotation is introduced

Q2) What is the difference in shape of Hybrid III head in comparison to ISO headform : Hybrid III geometry has been sent to Newtonlab for analysis

Q3) Is there any control of the skin vs aluminum contact? This is a critical aspect as we will focus on tangential impacts… Should we imagine a tangential control test? Yes test set up to be done by the group

# DISCUSSION WITH HUMANETICS (OPEN QUESTIONS)

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Q4) What are the characteristics of the current accelerometer amount designed to calculate the head rotational acceleration (method, type of transducer, filtering, price) :

## General:

- The "Sixpack" (HUM 3106 DTI) is a combination of 3 accelerometers and 3 gyroscopes which includes a standard 6 Channel DTI interface. The sensor has the dimensions of 37mm x 37mm x 30mm and weighs circa 80g.

- Only the linear acceleration in the three directions X Y Z is measured.
  If the resultant acceleration (translational movement) is required then you have to use a mathematical method, e.g. vector analysis, to calculate it.

- The gyroscopes provide the angle velocities around the rotational axes. If you want have the angular acceleration (rotational acceleration) then you must differentiate the angle velocity.

# DISCUSSION WITH HUMANETICS (OPEN QUESTIONS)

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Q4) What are the characteristics of the current accelerometer amount designed to calculate the head rotational acceleration (method, type of transducer, filtering, price) :

Accelerometer:

The transducer is from Measurement Specialties (MSI), model series 60. It is a piezoelectric accelerometer with a measurement range of 500g (2000g also available). For all other specifications please look in the attached datasheet.

The raw element signal pass one filter stage before it will be digitized with a16 Bit SAR converter at 20 kHz sampling rate.

The filter stage is a 4 kHz (- 3 dB). 4 Pole Butterworth anti-aliasing filter.

Anything except the sensor element, all electronics components are included on the used 307.3S DiMod DTI module from Hentschel.

# DISCUSSION WITH HUMANETICS (OPEN QUESTIONS)

UNIVERSITÉ DE STRASBOURG

Q4) What are the characteristics of the current accelerometer amount designed to calculate the head rotational acceleration (method, type of transducer, filtering, price) :

Gyroscope:

The transducer is based on an Analog Devices MEMS technology sensor element. In standard mode the element is useable for maximum 300°/sec. But the element is tunable for higher ranges with a special electronics circuit.

At the moment Humanetics accomplish ranges of 300-600-1200-2400 °/sec.

The raw element signal pass two filter stages before it will be digitized with a16 Bit SAR converter at 20 kHz sampling rate.

The first filter stage is a 1000Hz RC 1 pole low pass filter and the second stage is a 4 kHz (- 3 dB). 4 Pole Butterworth anti-aliasing filter.

All electronics components are included on the three used 345 DiMod DTI modules from Humanetics/Hentschel.

# DISCUSSION WITH HUMANETICS (OPEN QUESTIONS)

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Q5) Is there any chance to see a wireless solution? Not at the moment, especially for the rotation. Mass issues.

Q6) What is the best price of a full equipped H3 head?

| | |
|---|---|
| Hybrid III Head assembly: | 2022 € |
| Sixpack (3 accels and 3 ARS sensors) IES/3106: | 2125 € |
| Neck transducer 6 axis: | 9026 € |
| Head drop test rig TE-100-E: | 5715 € |

Q7) Do you see an interest of developing a specific headform for helmet test applications (bicycle+equitation+snow). This would represent a selling of about 200 heads.
This solution seams not to be possible !.

Q8) As it is not recommended to specify Hybrid III in the standard, could you help to define  how to define the headform? Document exist already

# DISCUSSION WITH HUMANETICS (OPEN QUESTIONS)

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Q9) We would eventually like to adapt the headform size by changing the skin thickness of the HIII headform. Do you think that this makes sense?
Clearly not, for both scientifical and economical reasons.

Q10) Do you have several sizes for Hybrid III neck (i.e. 90% 50% male, small female etc..) ? Yes this exists

Q11) Could Humanetics send a representative at our next meeting(Paris Sept 30 and October1st. They are still interested but not possible this time !

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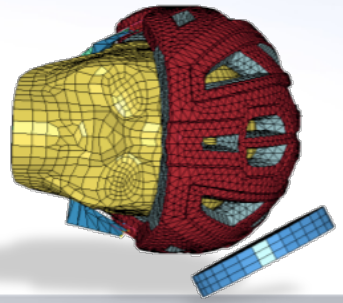

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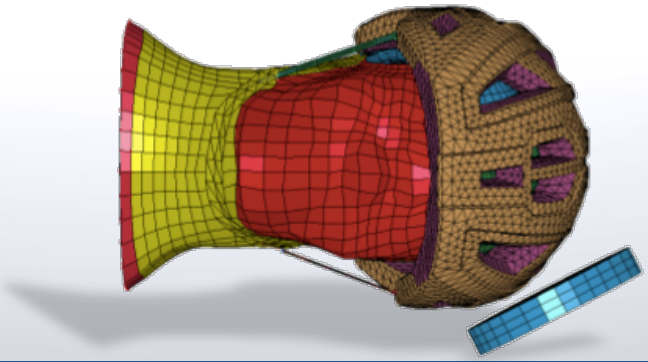

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