GTR7-07-02

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

Evaluation of the proposed certification test procedures

GTR 7 – Meeting

NHTSA-Office, Washington DC

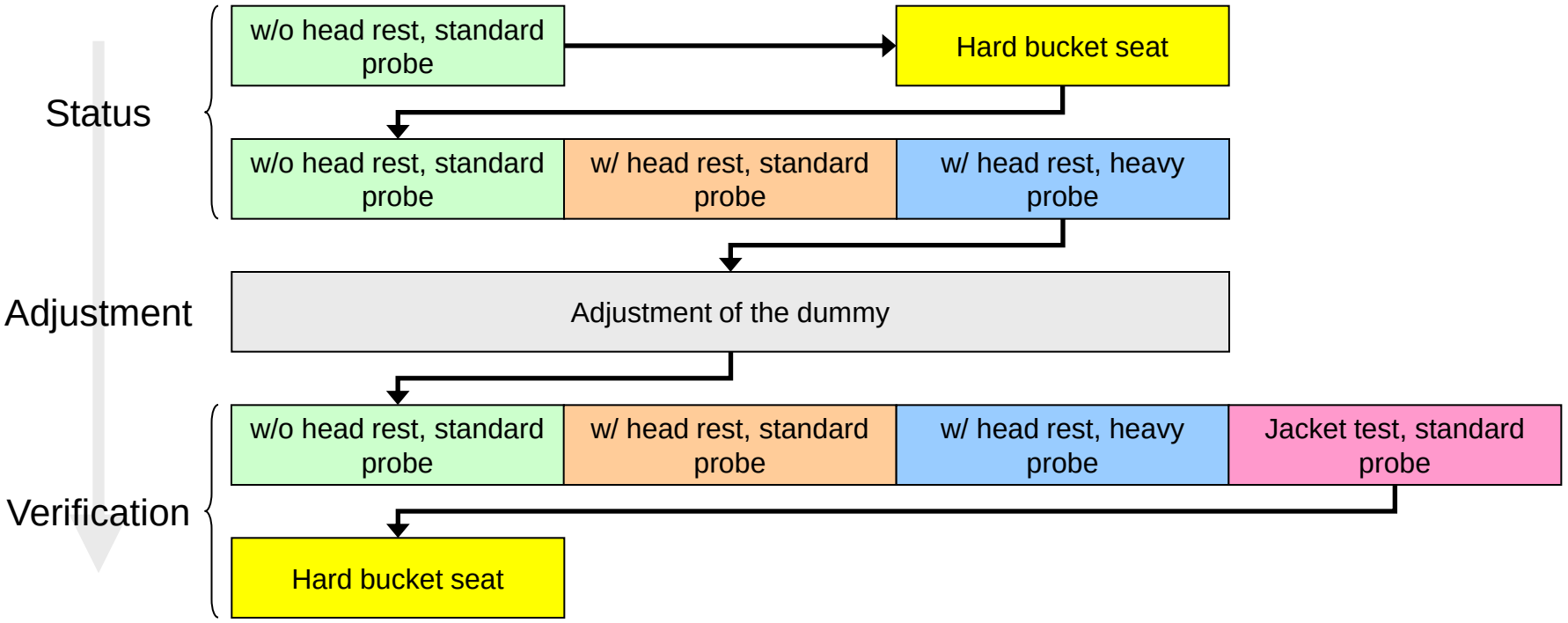
June 10th, 2011

Discussed certification tests

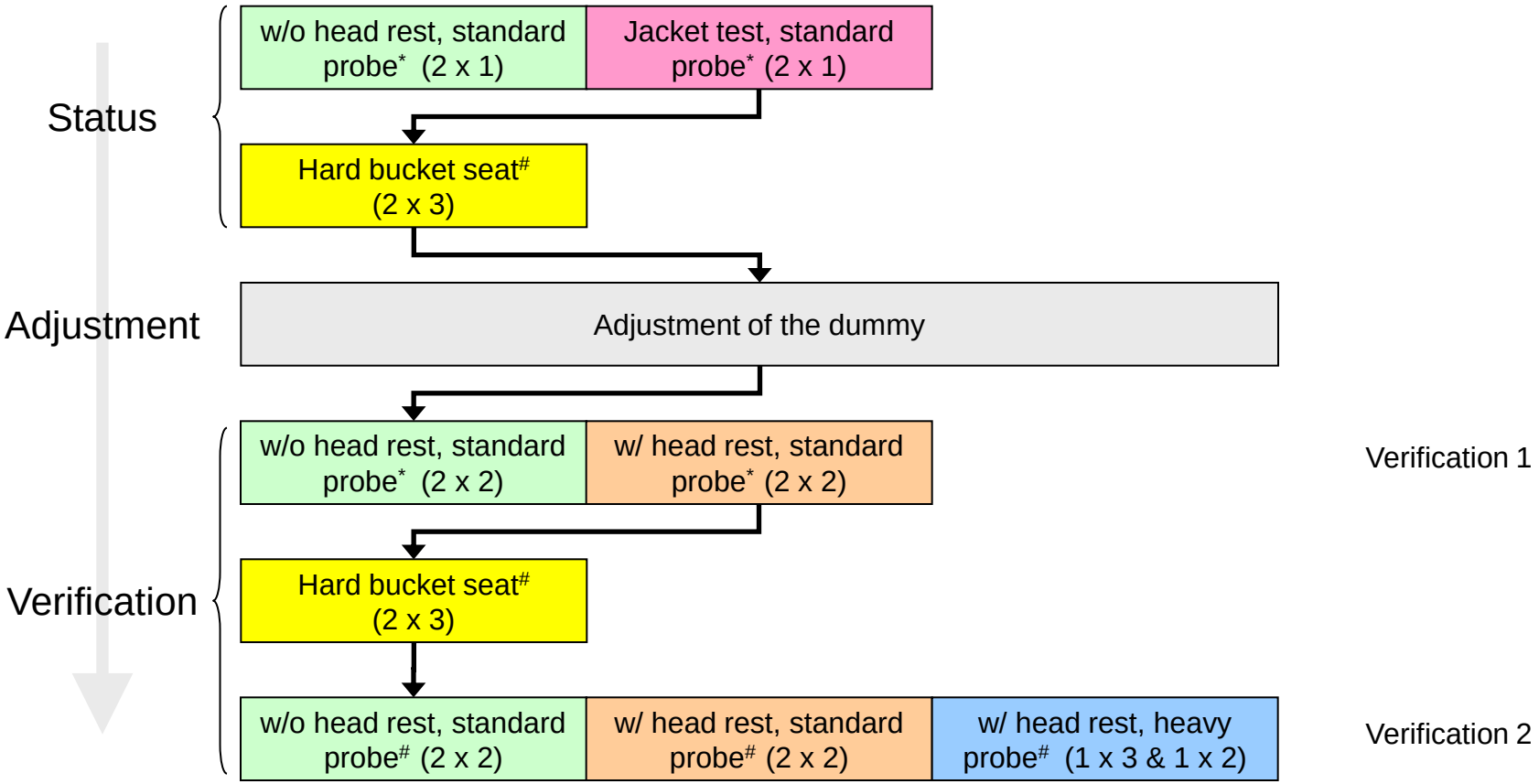
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

	Standard probe	Heavy probe
w/ Head rest	✓	✓
w/o Head rest	✓	
Torso jacket	✓	

Test matrix (intended)
Dummy D006 & D007



Test matrix (realised)
Dummy D006 & D007



* Instrumentation of Humanetics Europe

Instrumentation of PDB

Instrumentation

	Humanetics Europe	PDB
Head		Ax, Ay, Az
Upper neck	**Fx**, **Fz**, **My**	**Fx**, Fy, **Fz**, Mx, **My**, Mz
Lower neck		Fx, Fz, My
T1	**Ax**	**Ax**, Az (left, right)
Angles	Neck, torso	

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

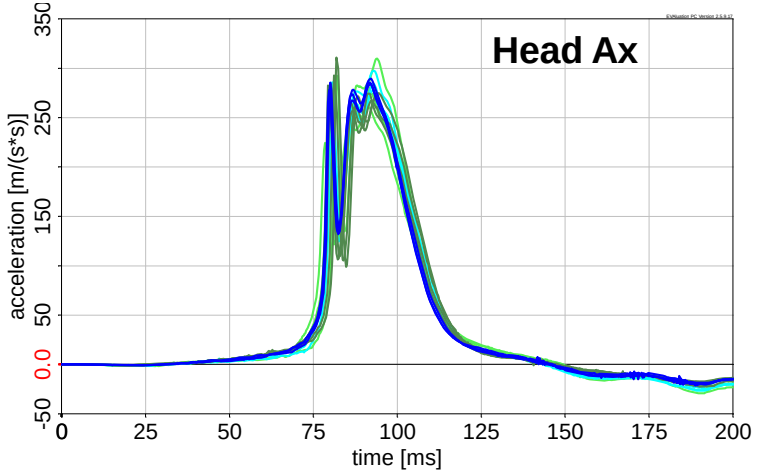
Results

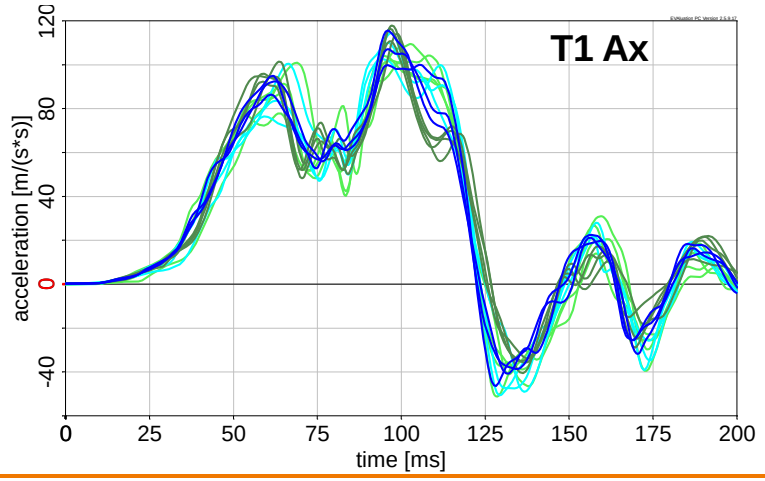
Hard bucket seat, SRA 16 crash pulse

Hard bucket seat – D006 vs. D007

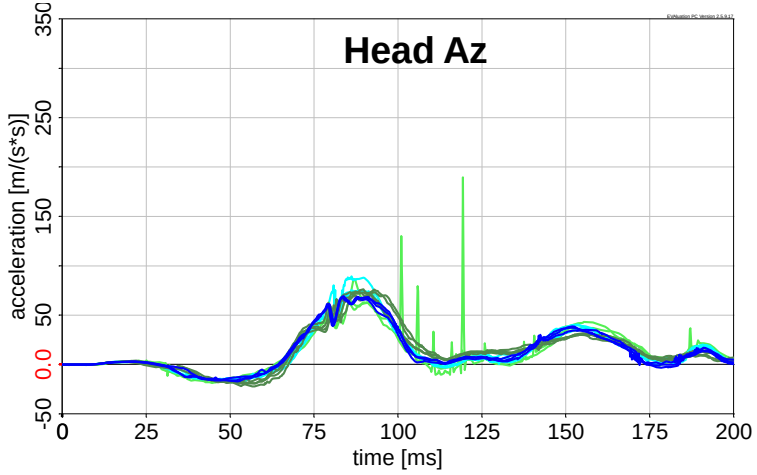
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

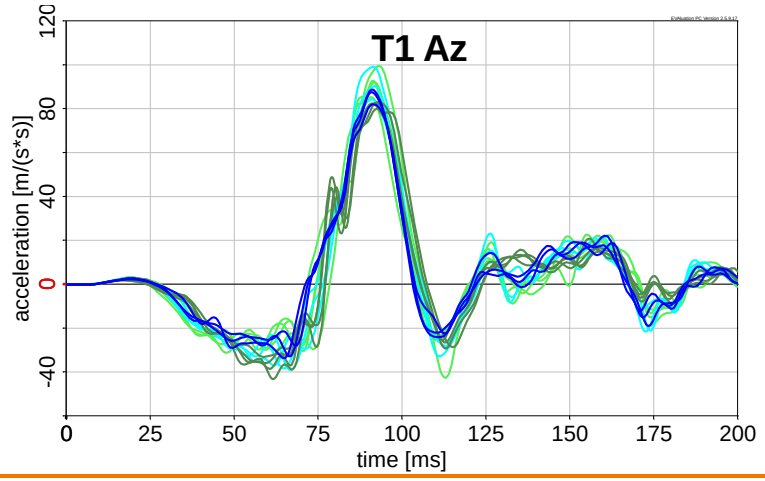
D006: Status – *Dy Adjust* – Verification





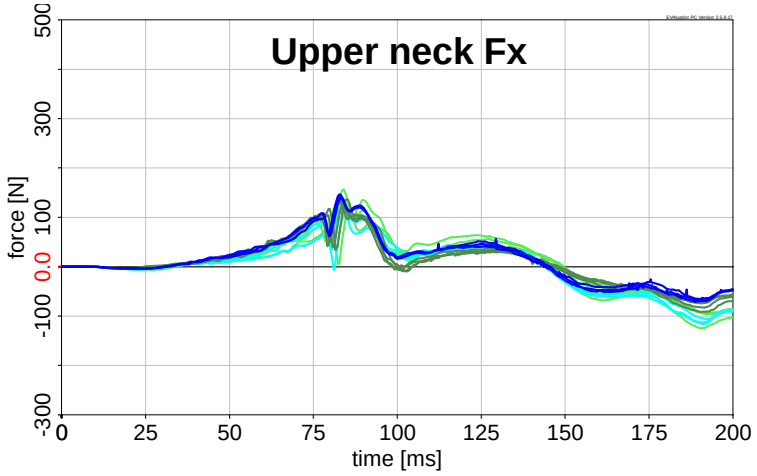
D007: Status – *Dy Adjust* – Verification

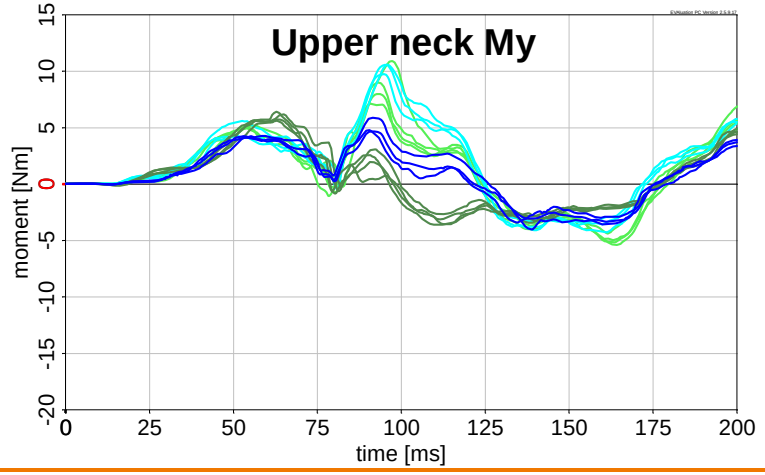




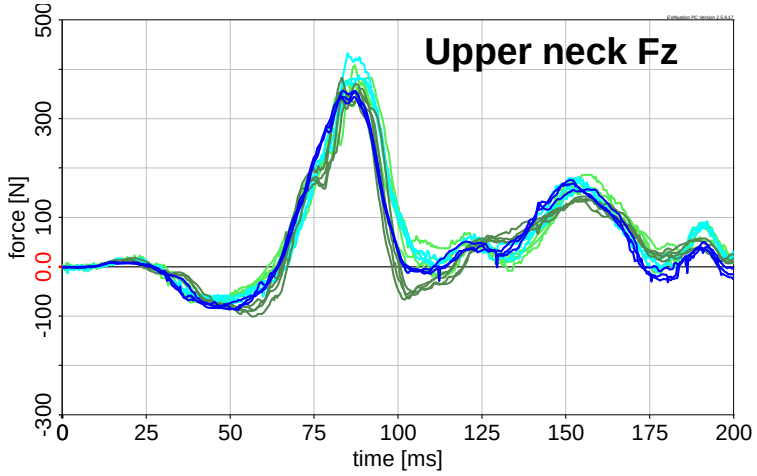
Hard bucket seat – D006 vs. D007

D006: Status – *Dy Adjust* – **Verification**



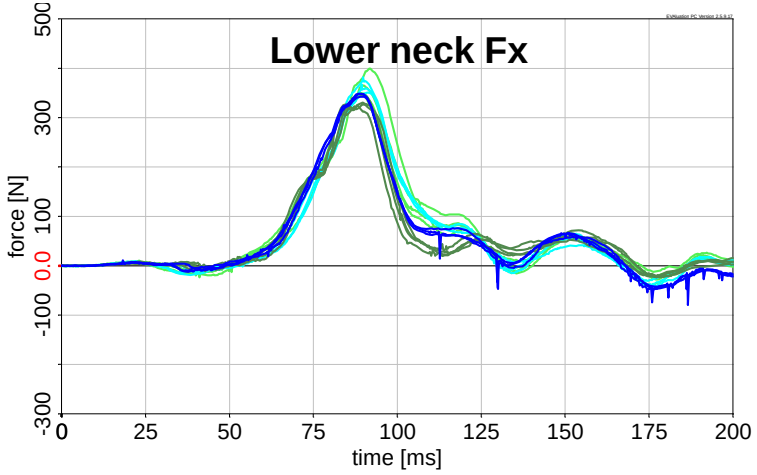


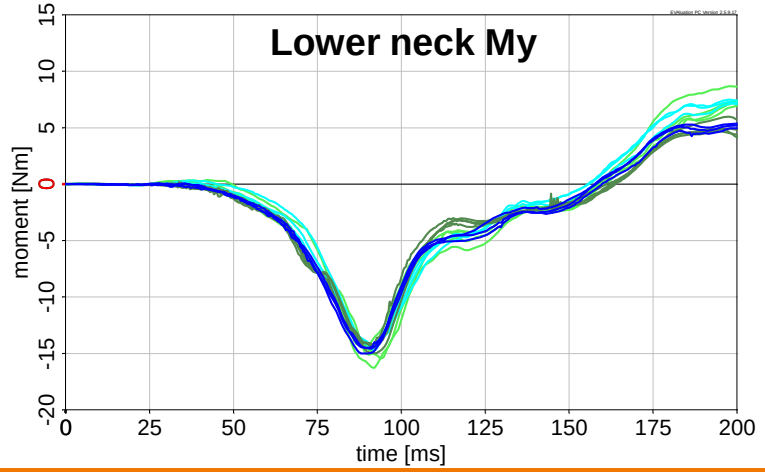
D007: Status – *Dy Adjust* – **Verification**



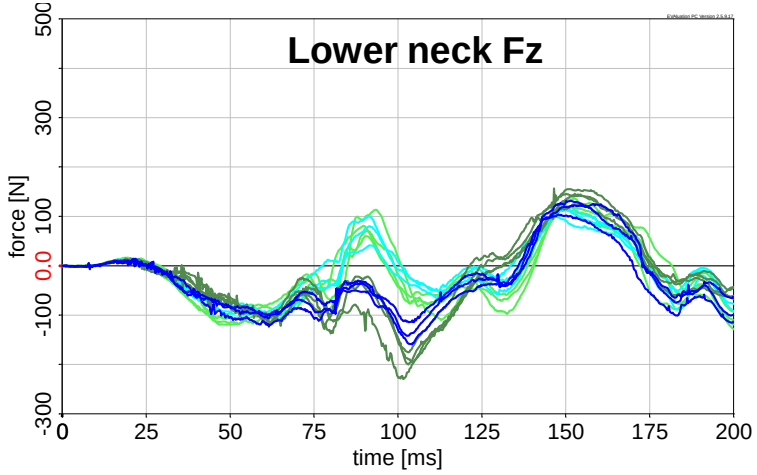
Hard bucket seat – D006 vs. D007

D006: Status – *Dy Adjust* – **Verification**





D007: Status – *Dy Adjust* – **Verification**



Hard bucket seat

- Data of status and verification tests available (before and after the adjustment of the dummies)
- Analysis of the signals
  - Accelerations
    - No significant differences between both dummies (variations of T1 accel. **>** head accel.)
    - Almost constant performance of each dummy (status and verification tests)
  - Forces and moments
    - Significant differences of the upper neck My and lower Fz characteristic between both dummies
    - Change of the performance after the dummy adjustment, however, relative difference remains the same

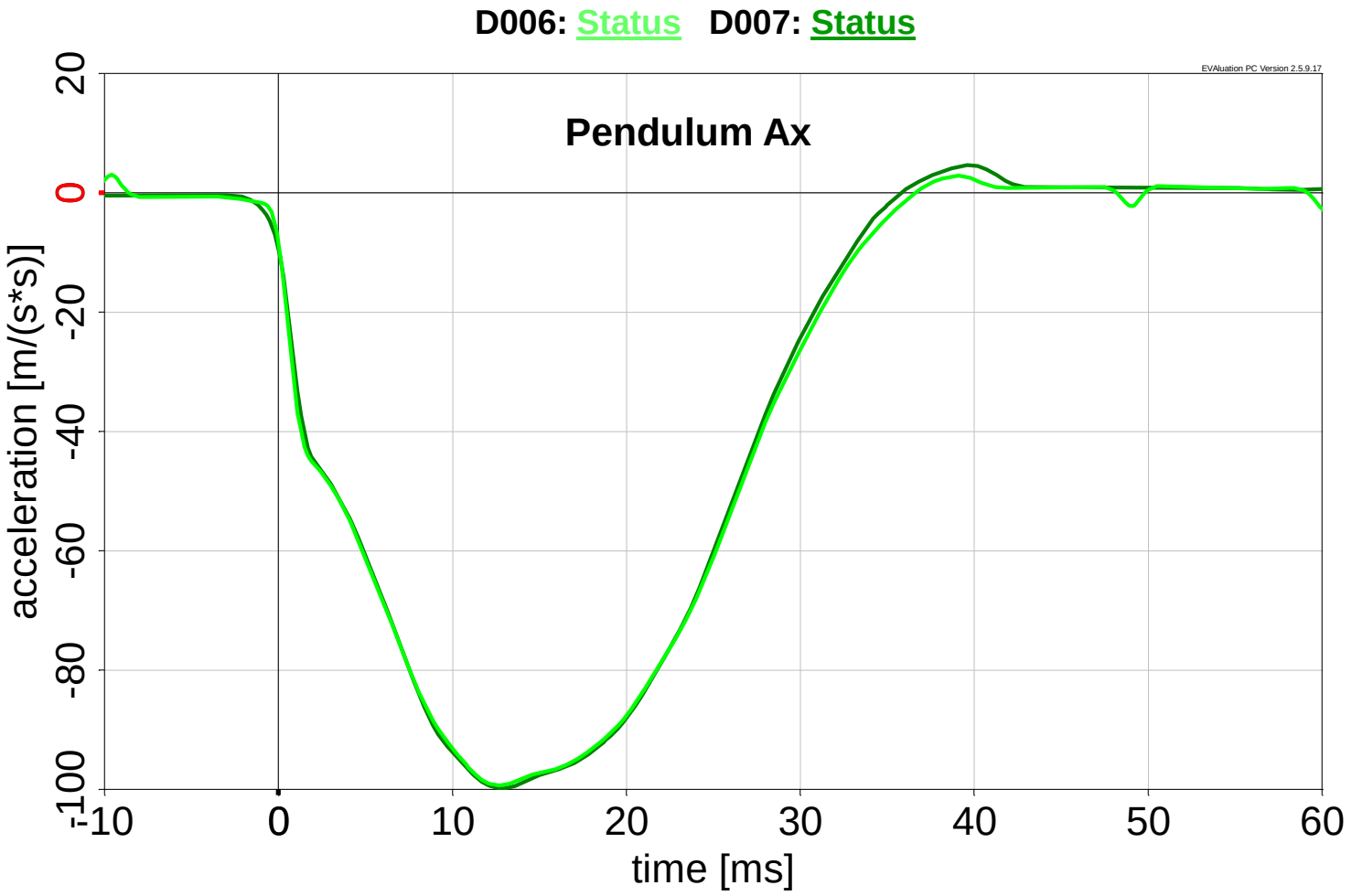
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

Results

Certification test of the torso jacket, standard probe

Certification – D006 vs. D007

Torso jacket, standard probe



PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

Results

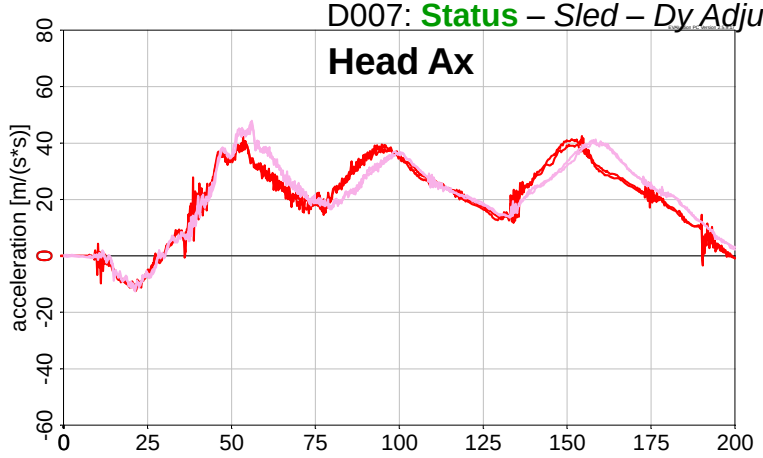
Certification tests w/o head rest, standard probe

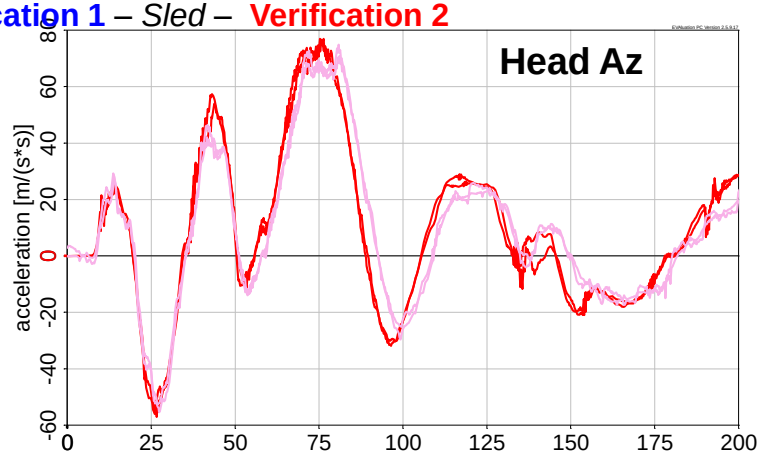
Certification – D006 vs. D007

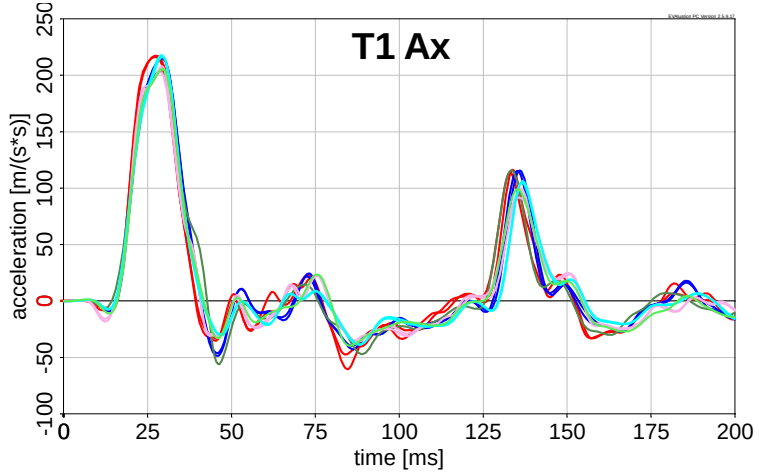
w/o head rest, standard probe

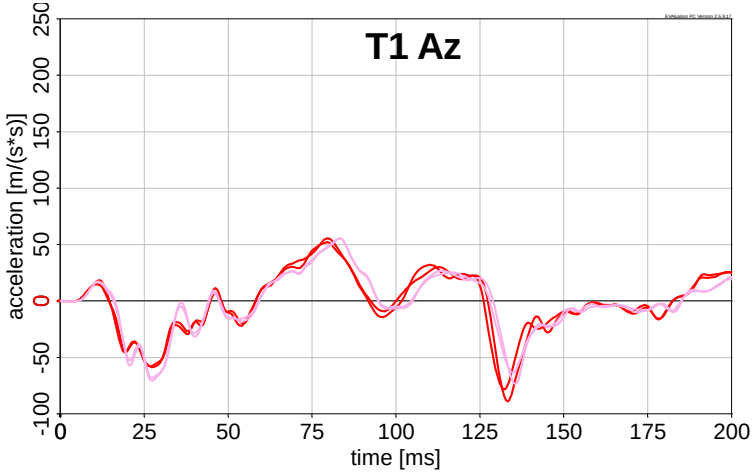
D006: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**







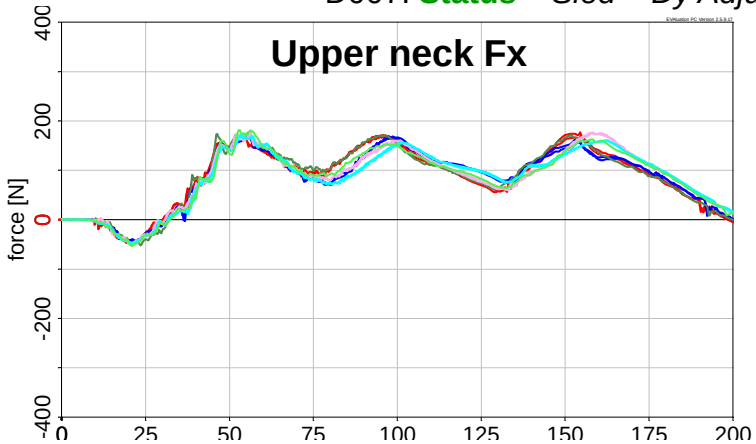


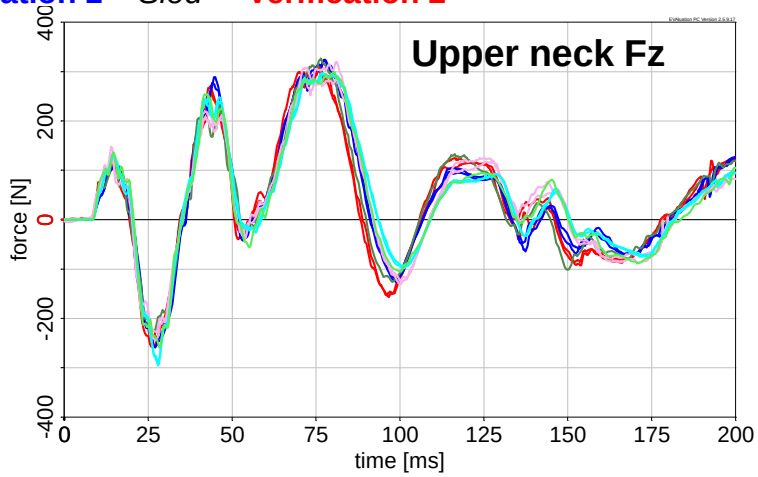
Certification – D006 vs. D007

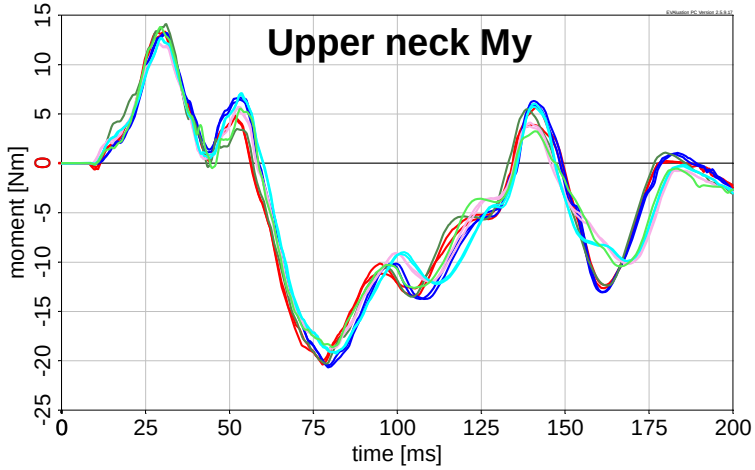
w/o head rest, standard probe

D006: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**







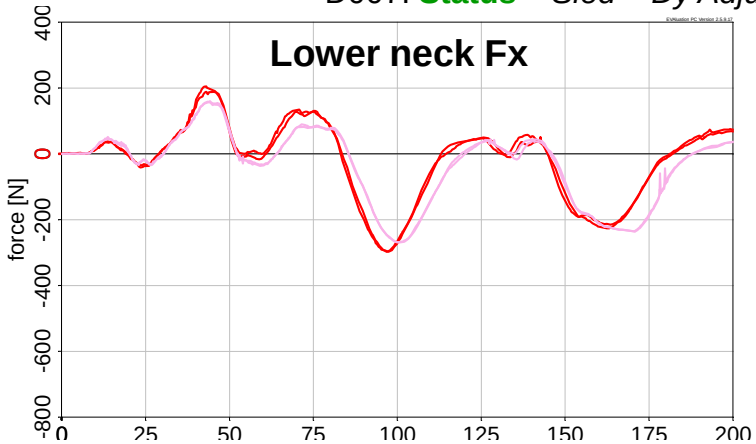
Certification – D006 vs. D007

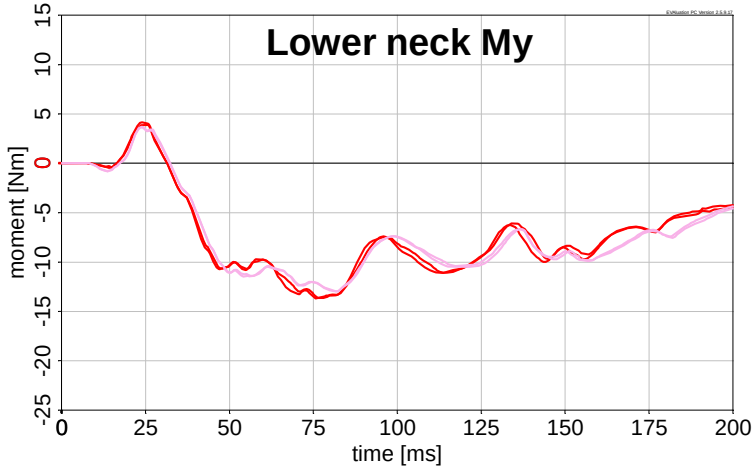
w/o head rest, standard probe

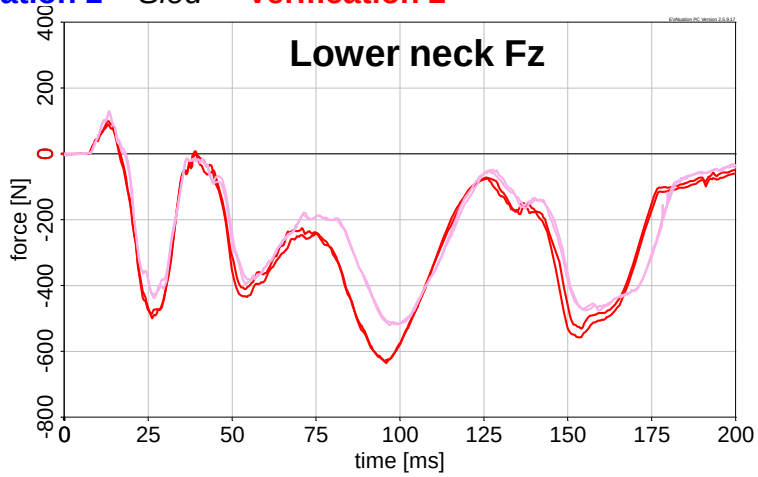
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

D006: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: **Status** – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**







No comparison possible due to missing measurements of **status** and **verificaton 1** certification at Humanetics

Certification
w/o head rest, standard probe

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

- Data of status and verification tests available
- Analysis of the signals:
  - Accelerations
    - No significant differences between both dummies
    - Constant performance of each dummy (status and verification tests)
  - Forces and moments
    - No significant differences between both dummies

➔ No differentiation!

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

Results

Certification tests with head rest, standard probe

>> No status test available <<

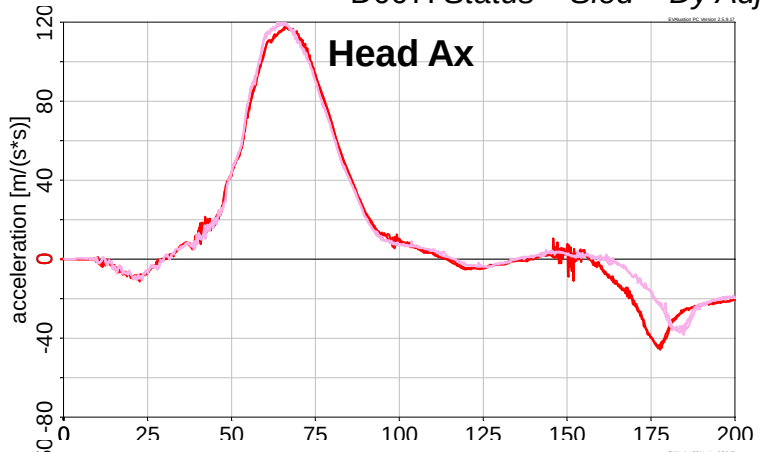
Certification – D006 vs. D007

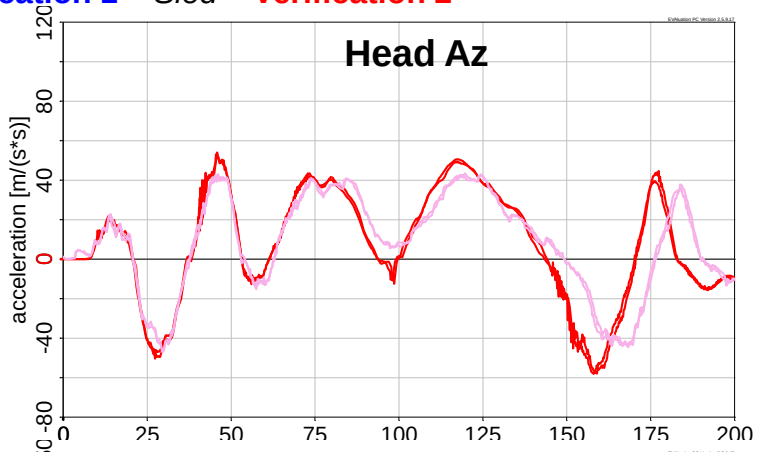
w/ head rest, standard probe

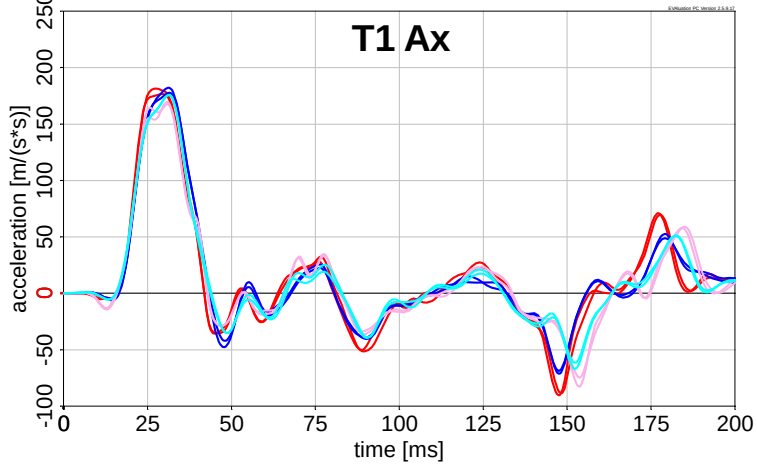
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

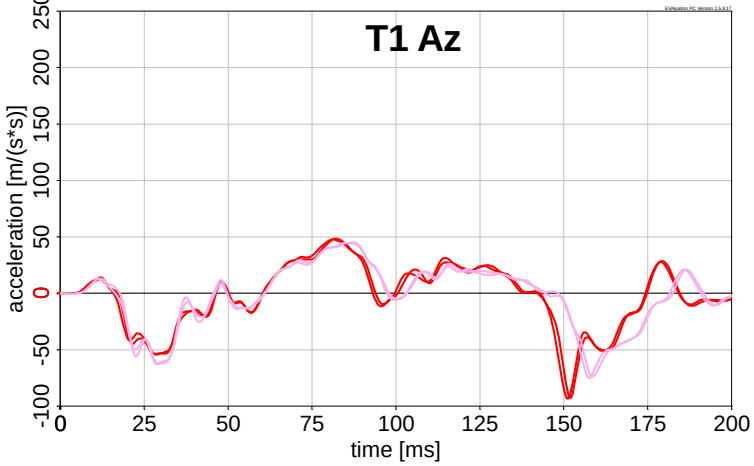
D006: *Status* – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: *Status* – *Sled* – *Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**









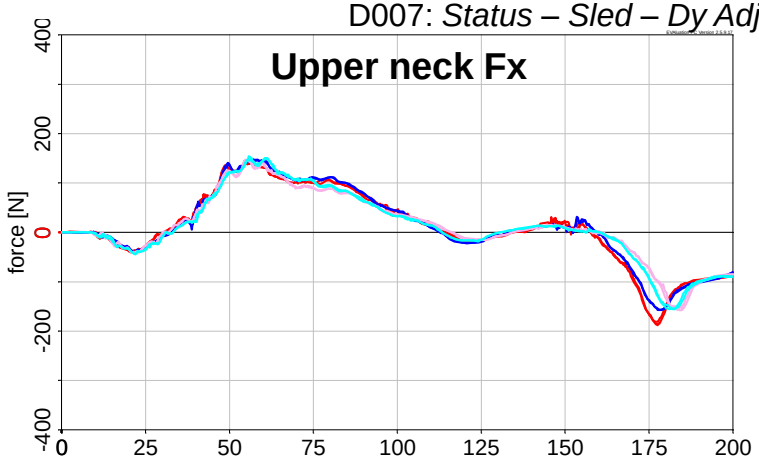
Certification – D006 vs. D007

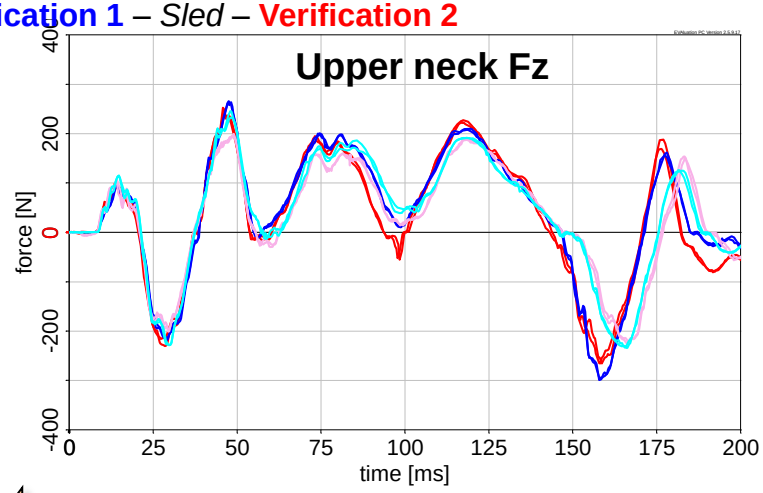
w/ head rest, standard probe

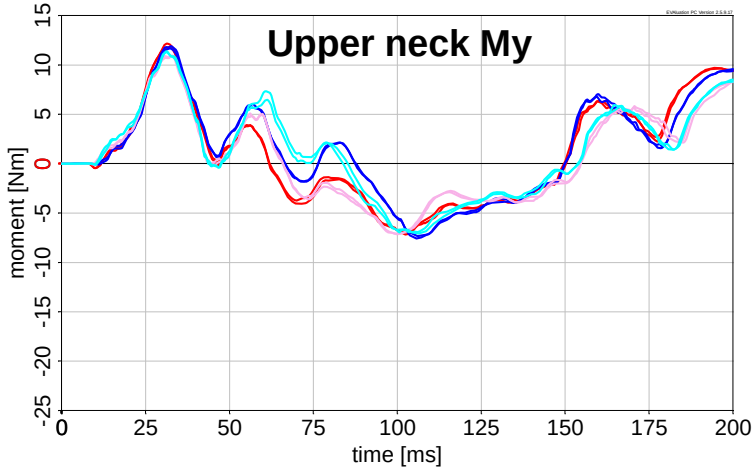
PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

D006: *Status – Sled – Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: *Status – Sled – Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**





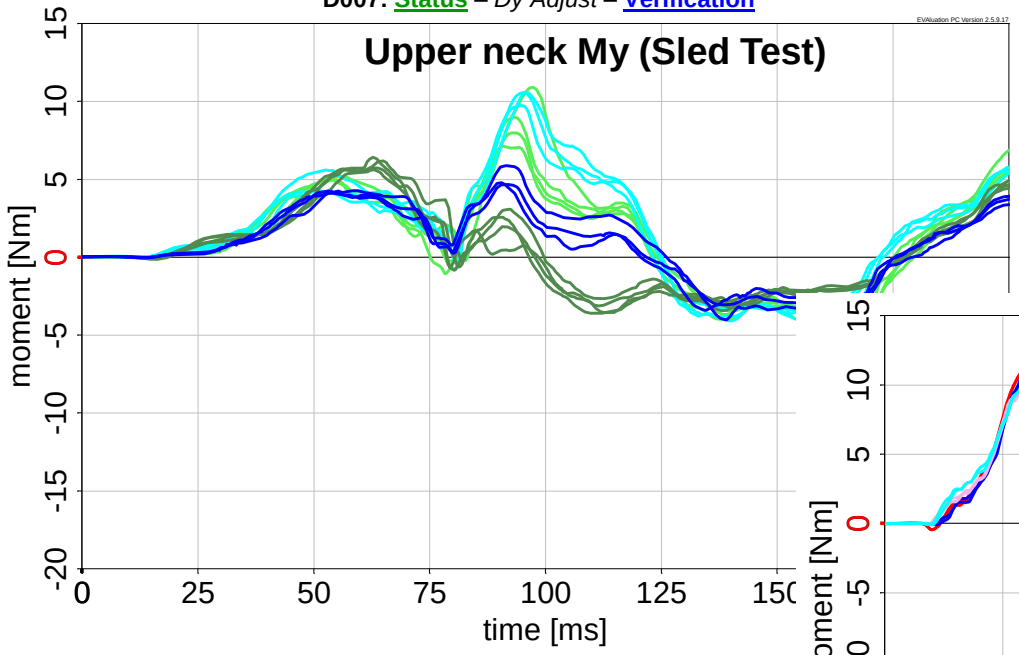


- **Signals of both dummies shifted between verification 1 & 2**
- **Differences between D006 and D007 remain constant**

Sled versus Certification

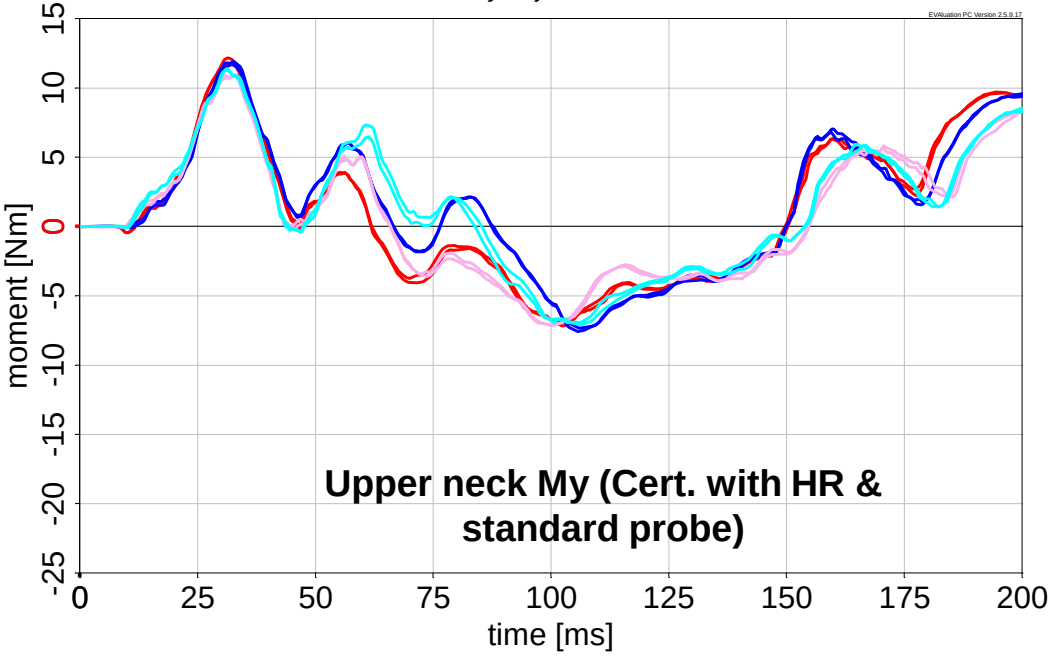
D006: Status – *Dy Adjust* – Verification

D007: Status – *Dy Adjust* – Verification



D006: *Status – Sled – Dy Adjust* – Verification 1 – *Sled* – Verification 2

D007: *Status – Sled – Dy Adjust* – Verification 1 – *Sled* – Verification 2



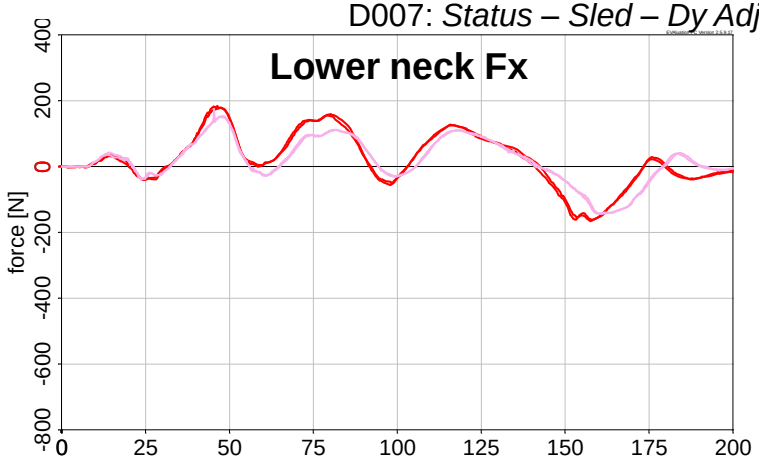
- **Differences of the dummy response can clearly be seen in sled tests**
- **Certification test does not indicate these differences clearly**

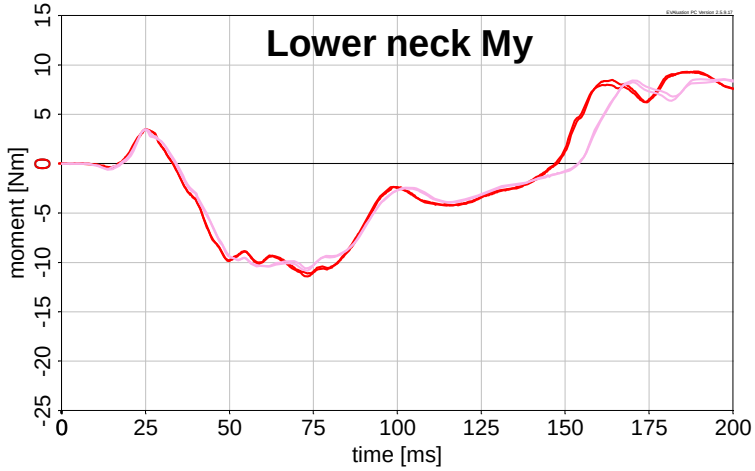
Certification – D006 vs. D007

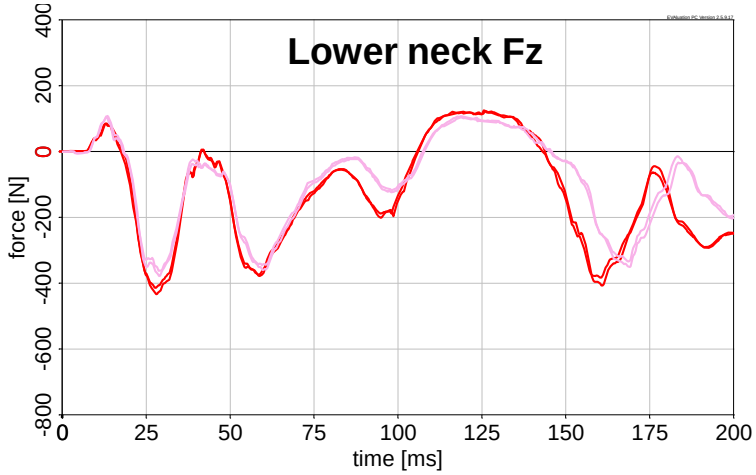
w/ head rest, standard probe

D006: *Status – Sled – Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**

D007: *Status – Sled – Dy Adjust* – **Verification 1** – *Sled* – **Verification 2**







No comparison possible due to missing measurements of **status** and **verificaton 1** certification at Humanetics

Certification
w/ head rest, standard probe

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

- Only data of the verification tests available (after the adjustment of the dummies)
  - ➔ No information on the influence of the dummy adjustment
- Analysis of the signals
  - Accelerations
    - No significant difference between both dummies
    - Constant performance of each dummy (verification tests 1&2)
  - Forces and moments
    - Reduction of the upper neck moment My of both dummies in the second verification tests (probably due to sled test)
    - Differences of My signals remain the same

PARTNERSHIP FOR DUMMY TECHNOLOGY AND BIOMECHANICS

Results

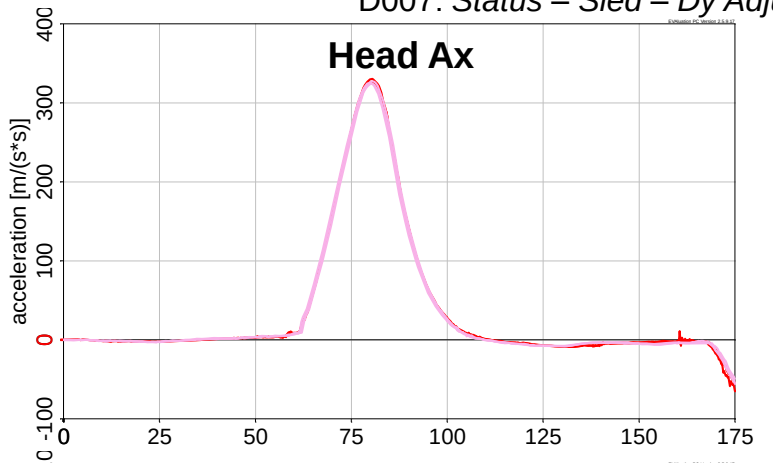
Certification tests with head rest, heavy probe

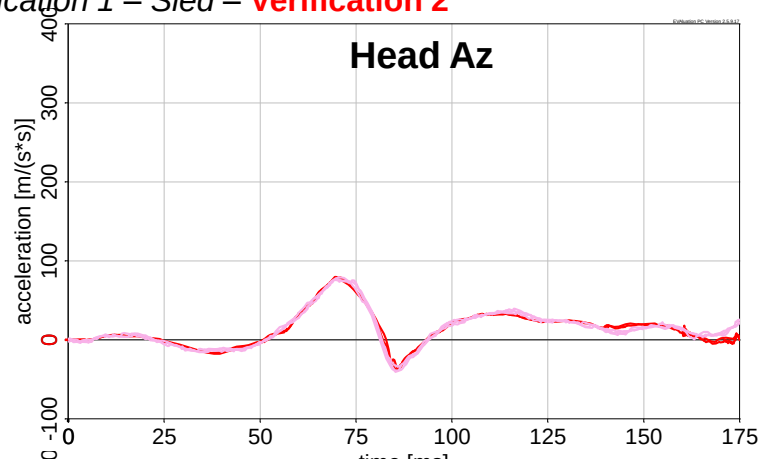
Certification – D006 vs. D007

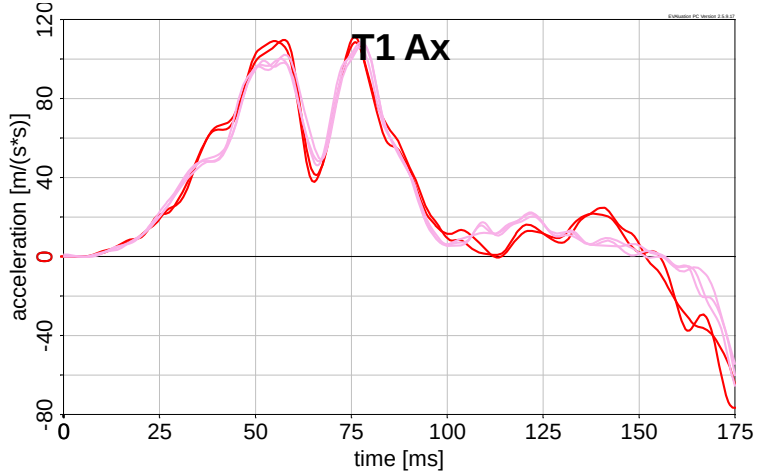
head rest, heavy probe

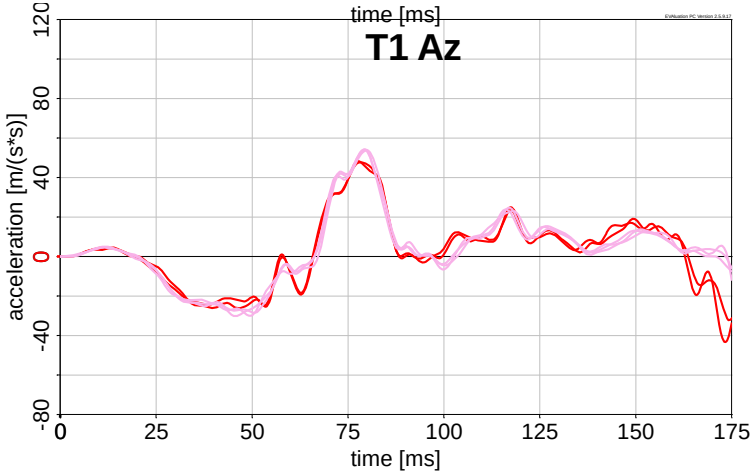
D006: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**

D007: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**







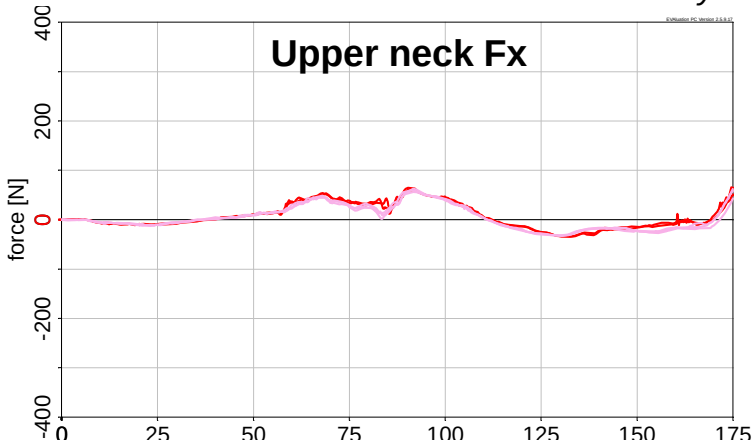


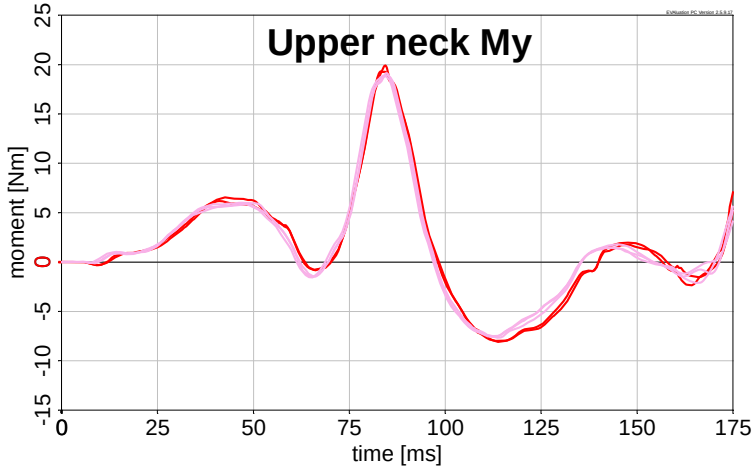
Certification – D006 vs. D007

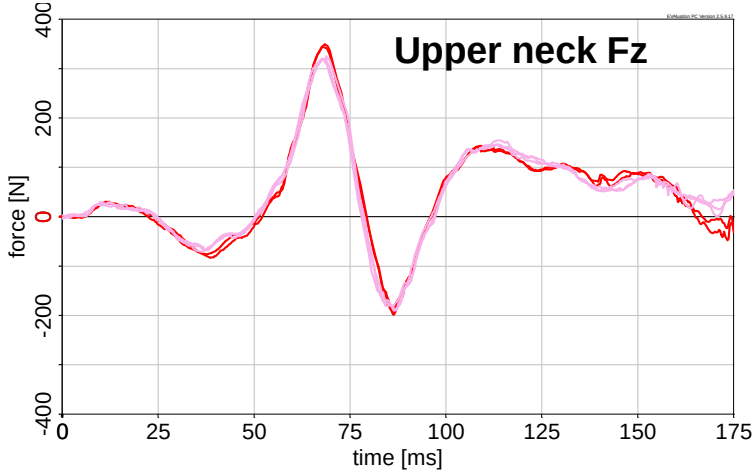
head rest, heavy probe

D006: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**

D007: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**





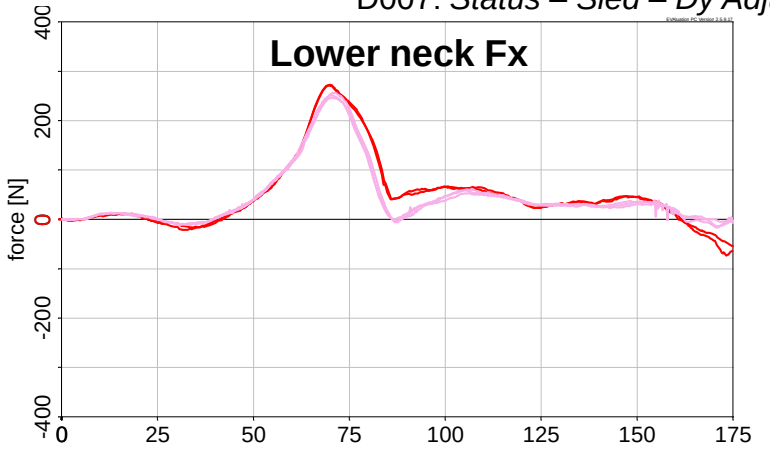


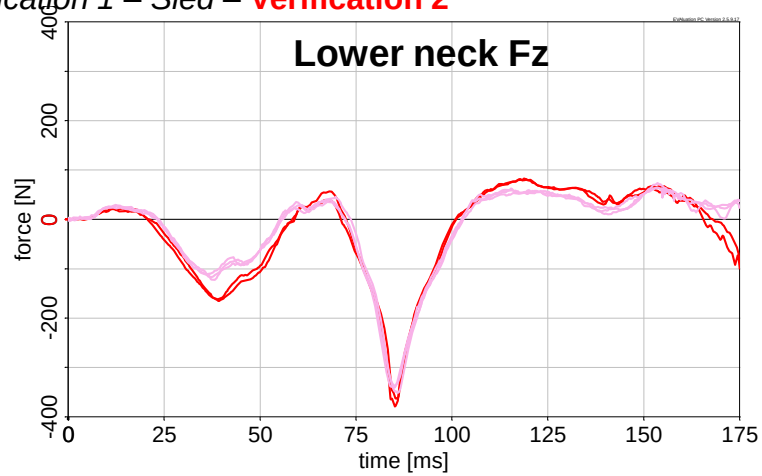
Certification – D006 vs. D007

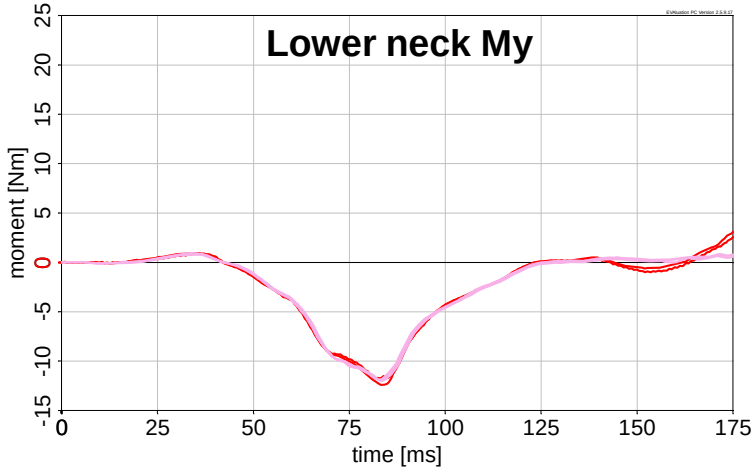
head rest, heavy probe

D006: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**

D007: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**





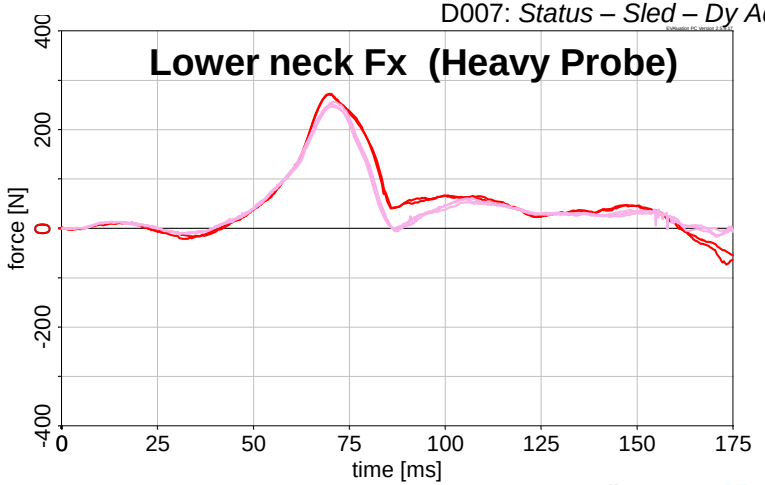


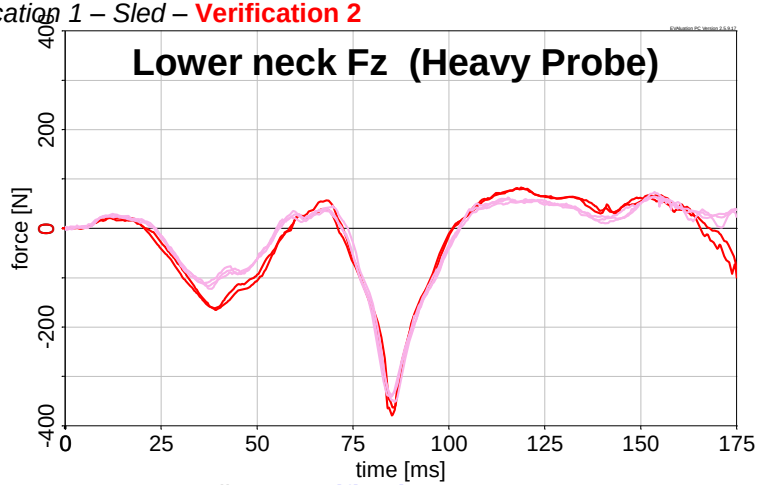
Certification versus Sled

head rest, heavy probe

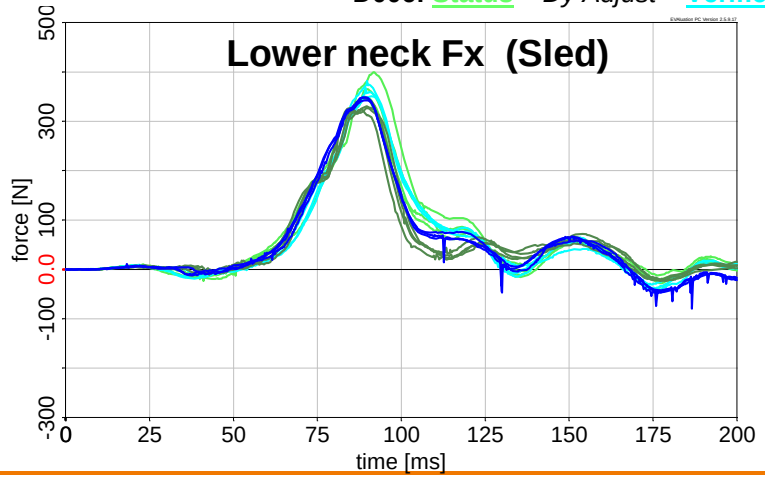
D006: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**

D007: *Status – Sled – Dy Adjust – Verification 1 – Sled –* **Verification 2**

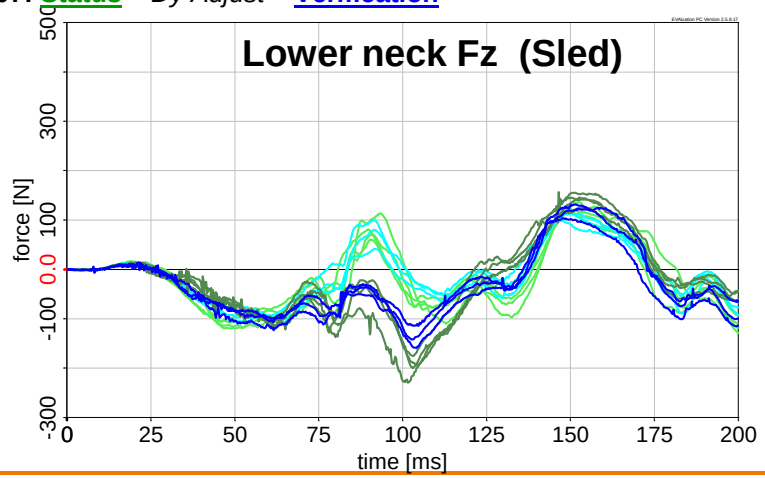




D006: Status – *Dy Adjust* – Verification



D007: Status – *Dy Adjust* – Verification



Certification
head rest, heavy probe

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- Only data of verification 2 available (after dummy adjustment and sled tests)
  - ➔ No information on the influence of the dummy adjustment
- Analysis of the signals
  - Accelerations
    - No significant difference between both dummies
  - Forces and moments
    - Similar upper neck forces and moments of both dummies
    - Differences in lower neck Fx and Fz (before head contact)

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Summary & Conclusion

Summary

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- Hard bucket seat tests
  - Differences between both dummies
- Certification of torso jacket with standard probe
  - No difference between both dummies
  - Global properties are more important than local material stiffness
- Certification w/o head rest and standard probe
  - Test does not distinguish between both dummy specimen

Summary

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- Certification with head rest and standard probe
  - Test differentiates between BioRID specimen
    - Differences are not significant
    - Findings must be verified with other BioRID specimen
  - Changed My characteristics of both dummies after the tests with the hard bucket seat (verification 1 & 2)
- Certification with head rest and heavy probe
  - Accelerations and upper neck responses does not distinguish between the both dummy specimen
  - Lower neck Fx and Fz show differences. However, data base is not sufficient to conclude.

Remaining Question

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- If a certification test differentiates between BioRID specimen…….

  ……what are the parameters to adjust the dummies to get the same performance?

Conclusion

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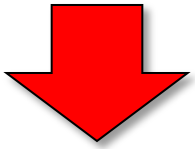
- BioRID was originally developed for kinematic assessments
  - Later introduction of upper and lower neck load cells
- R & R:
  - Acceptable for accelerations
  - Unacceptable for forces and moments to be used for injury assessments



Current BioRID version seems to be sufficient for kinematic assessment only.