

Latest Investigations into BioRID-II Dummy Variation

Paul Depinet, John Below,
John Arthur, Mike Beebe,
Charlie Steinmetz, Alex Schmitt
Gus Serrano, Keith Alto

Feb. 28, 2011

Content

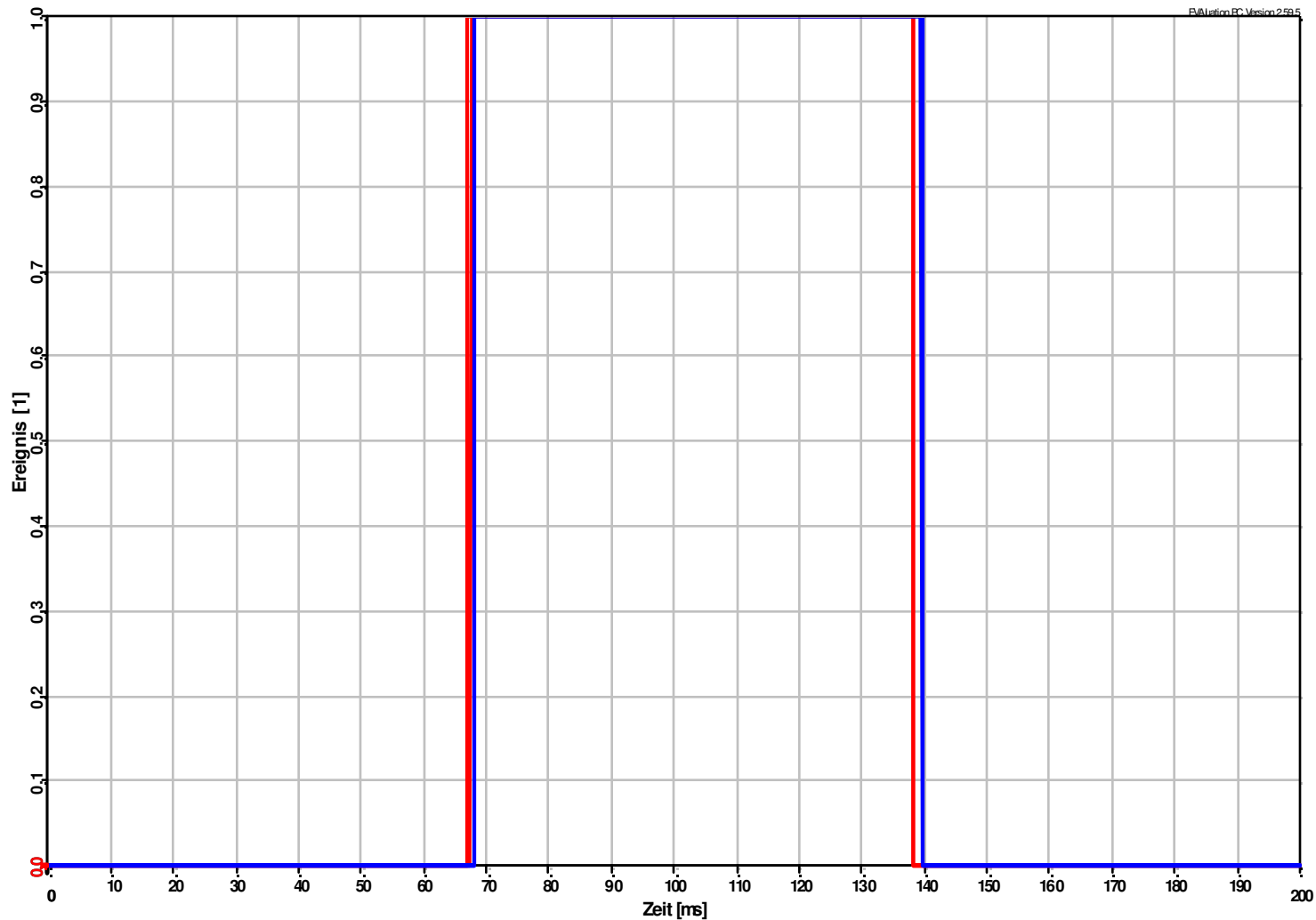
- ▶ Jacket Stiffness affects on Sports Seat
- ▶ Further jacket stiffness experience
- ▶ Normal vs Loose pins
- ▶ Update to Effects Summary Chart

JACKET STIFFNESS STUDY IN A SPORTS SEAT

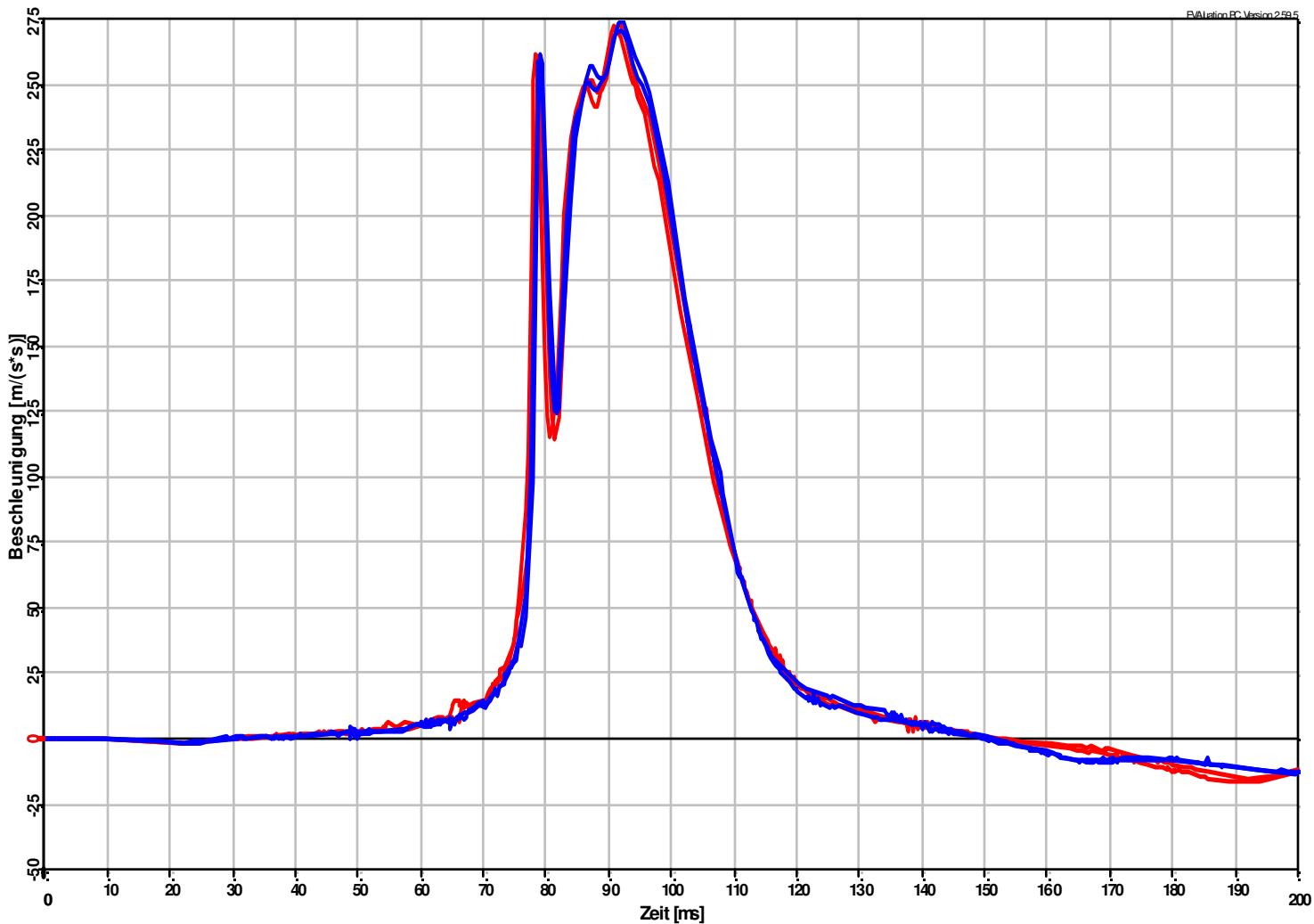
Jacket Stiffness Study

- ▶ Stiff and Soft jackets from prior certification test studies provided to PDB for Seat Testing
 - These jackets show differences in all certification tests
- ▶ Jackets tested in Sports Seat
 - Tested on dummy 7 from prior R&R studies
 - Blue = SOFT, Red = STIFF
 - Each jacket tested two times

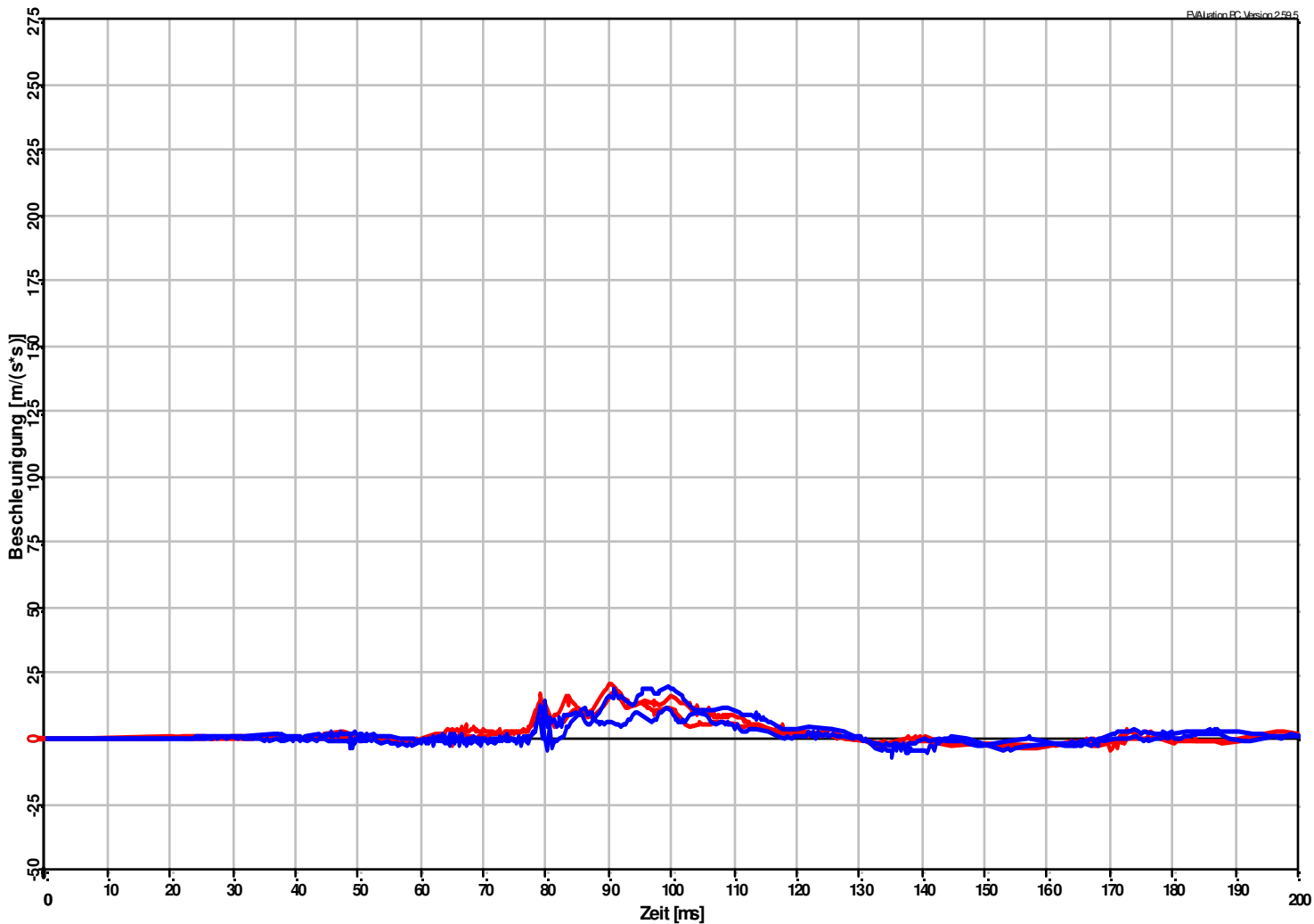
Kurvenvergleich Nr. 1, S1HEAD0000BREV00



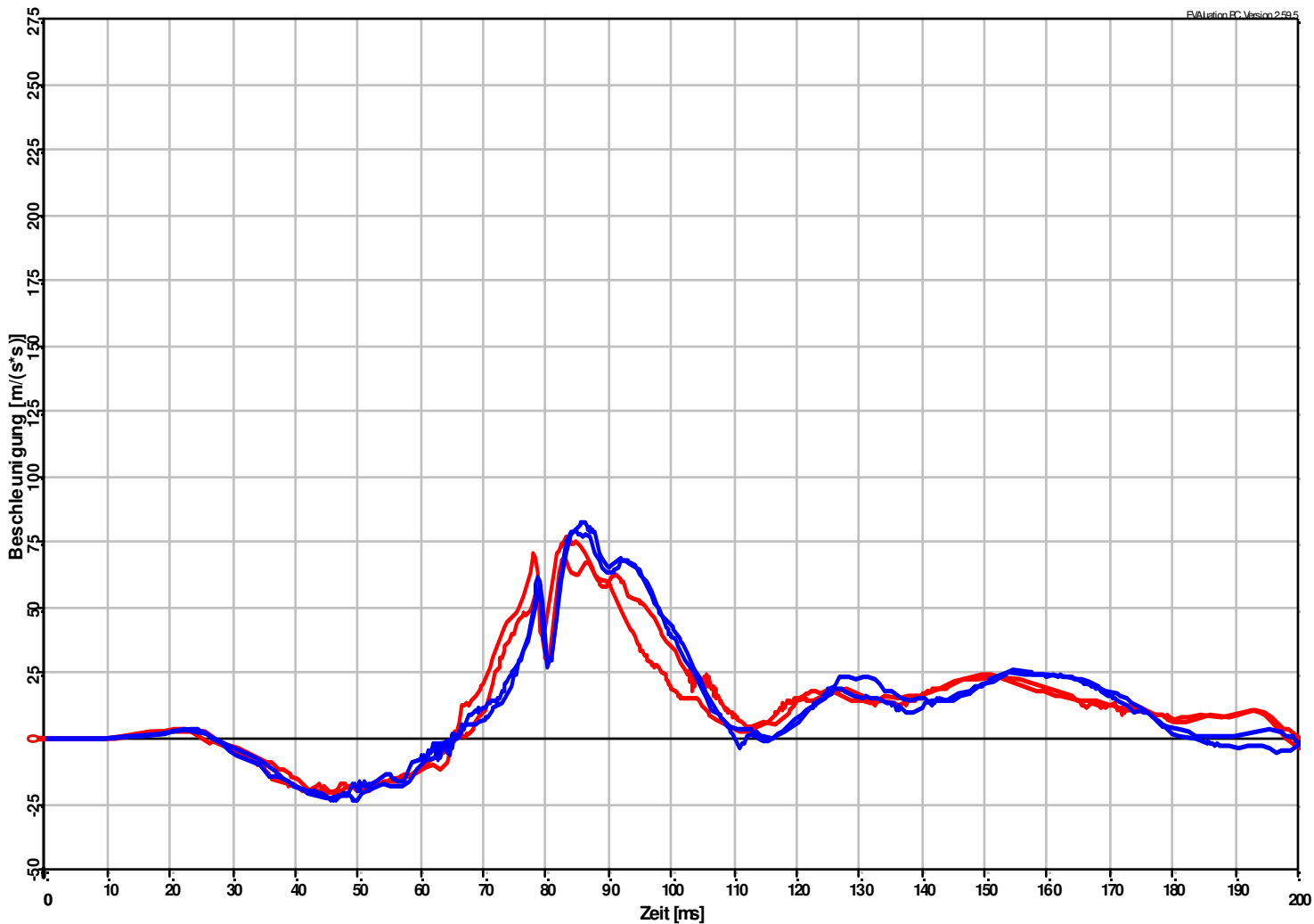
Kurvenvergleich Nr. 1, S1HEAD0000BRACXA



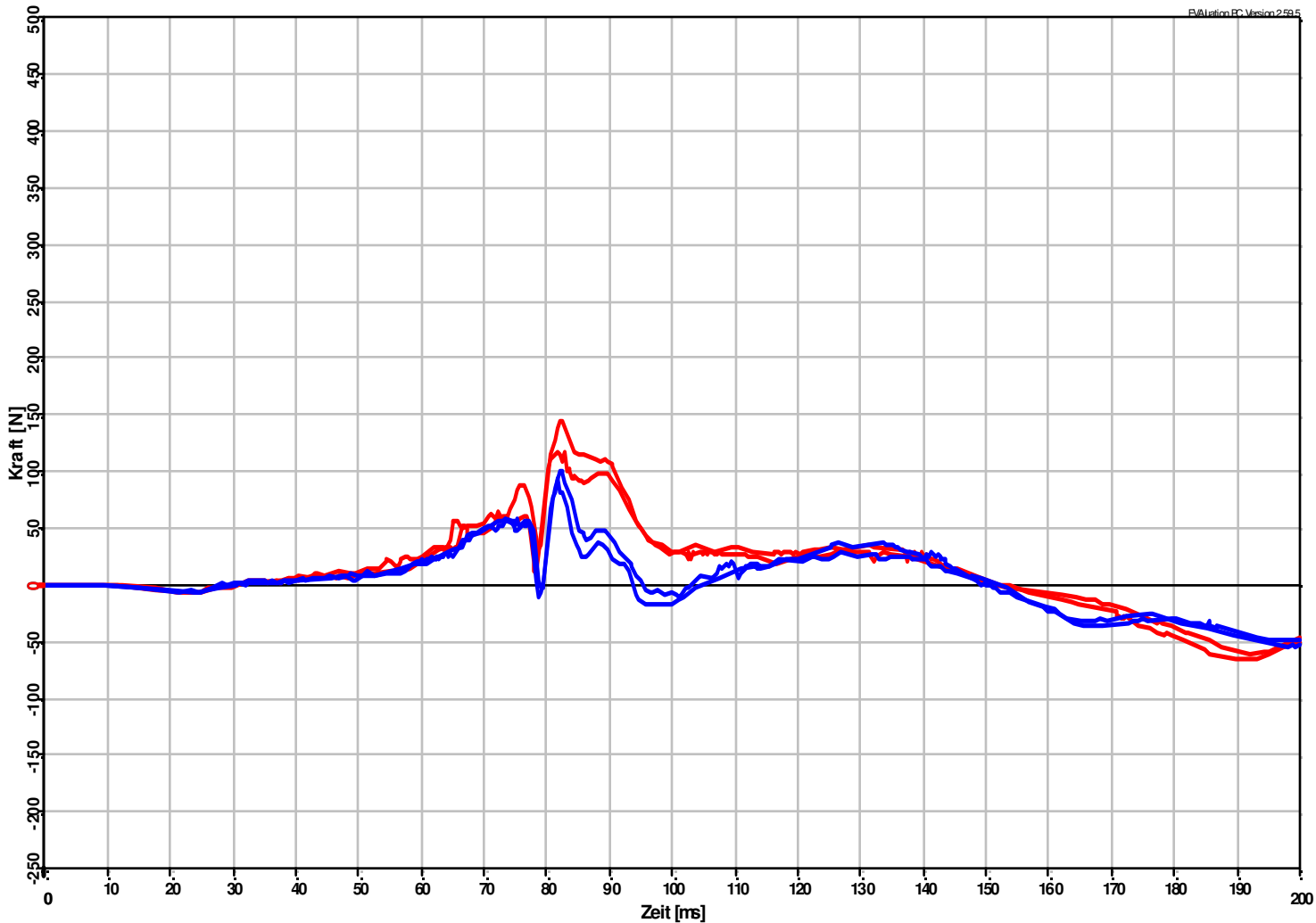
Kurvenvergleich Nr. 1, S1HEAD0000BRACYA



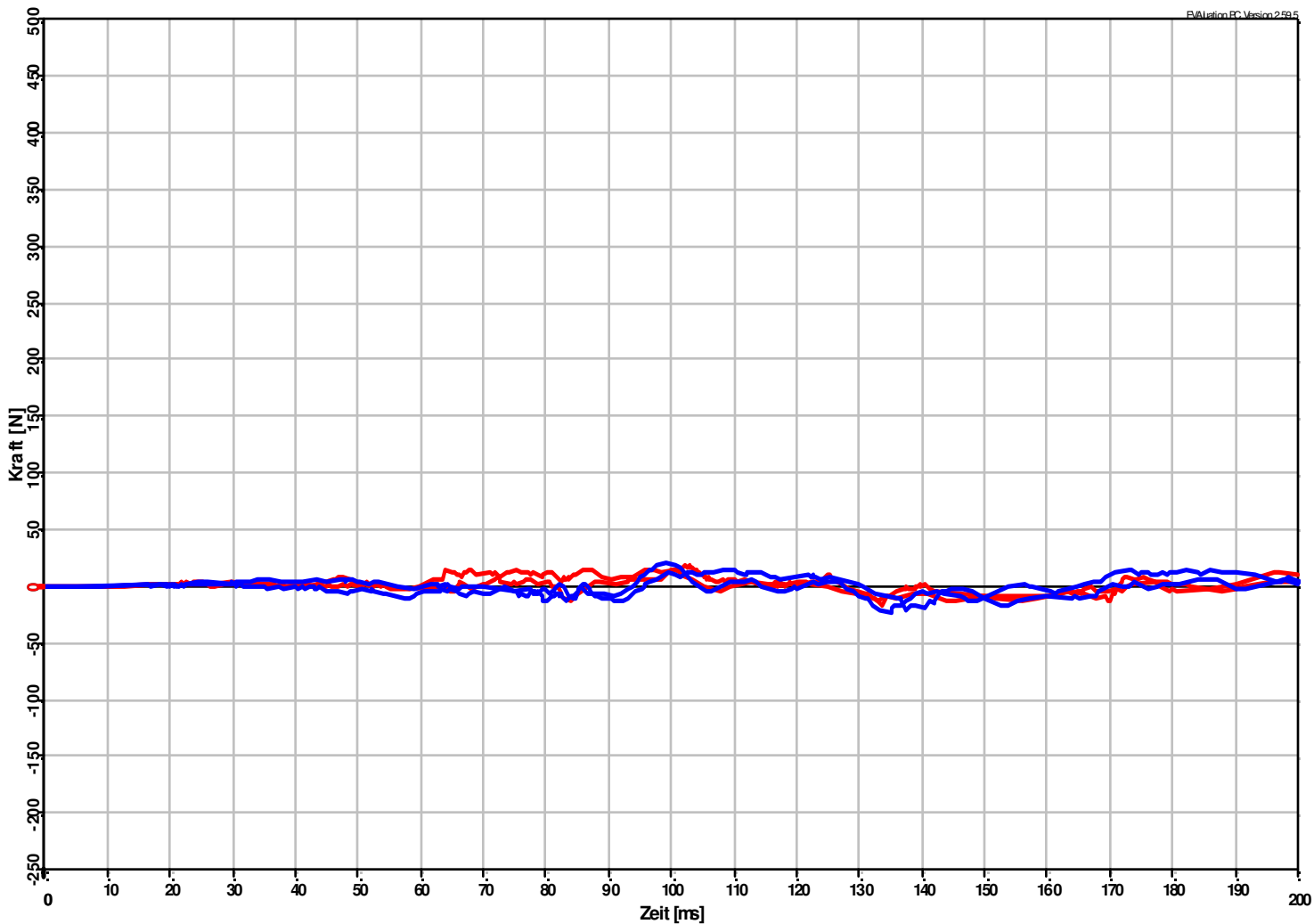
Kurvenvergleich Nr. 1, S1HEAD0000BRACZA



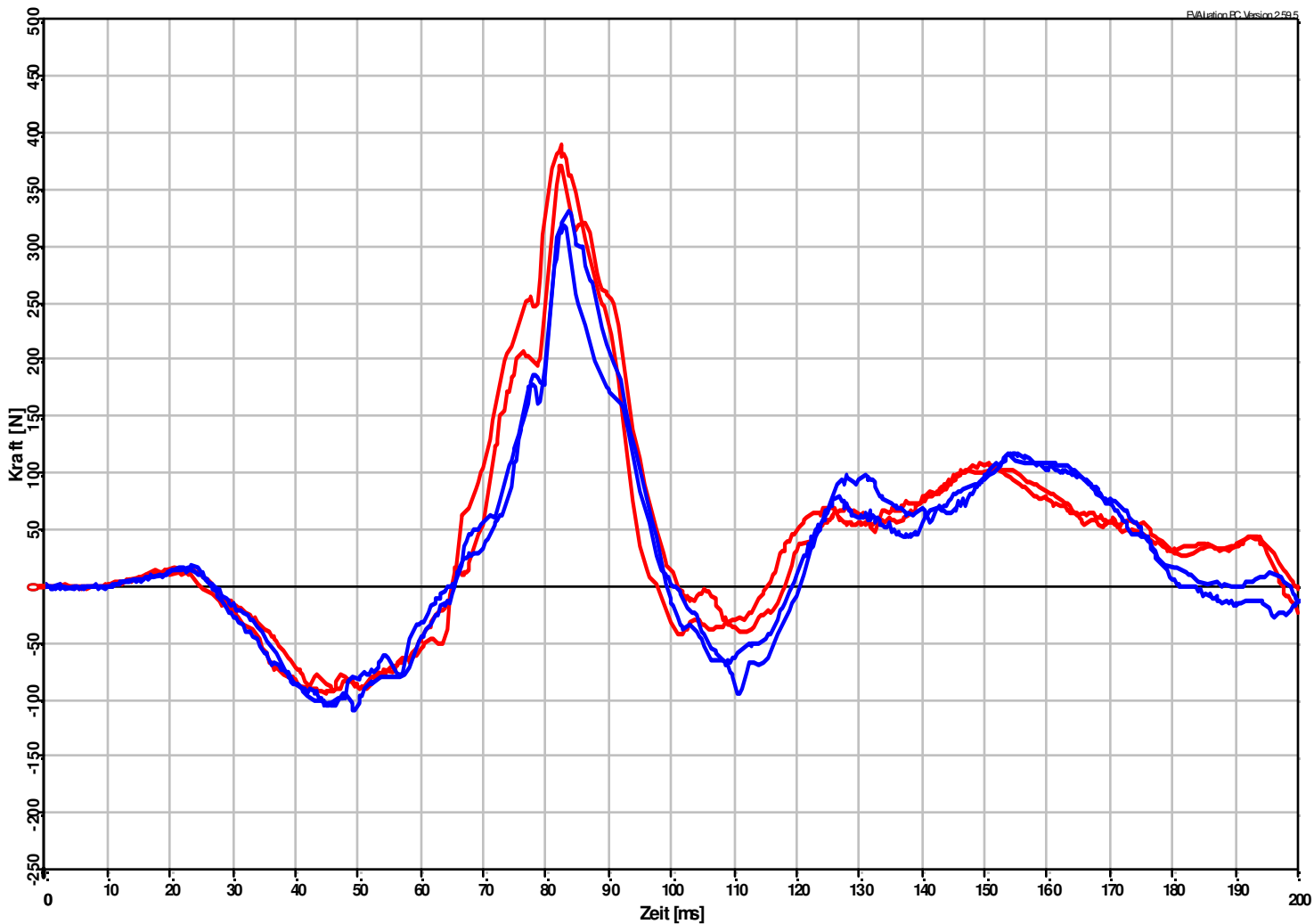
Kurvenvergleich Nr. 1, S1NECKUP00BRFOXA



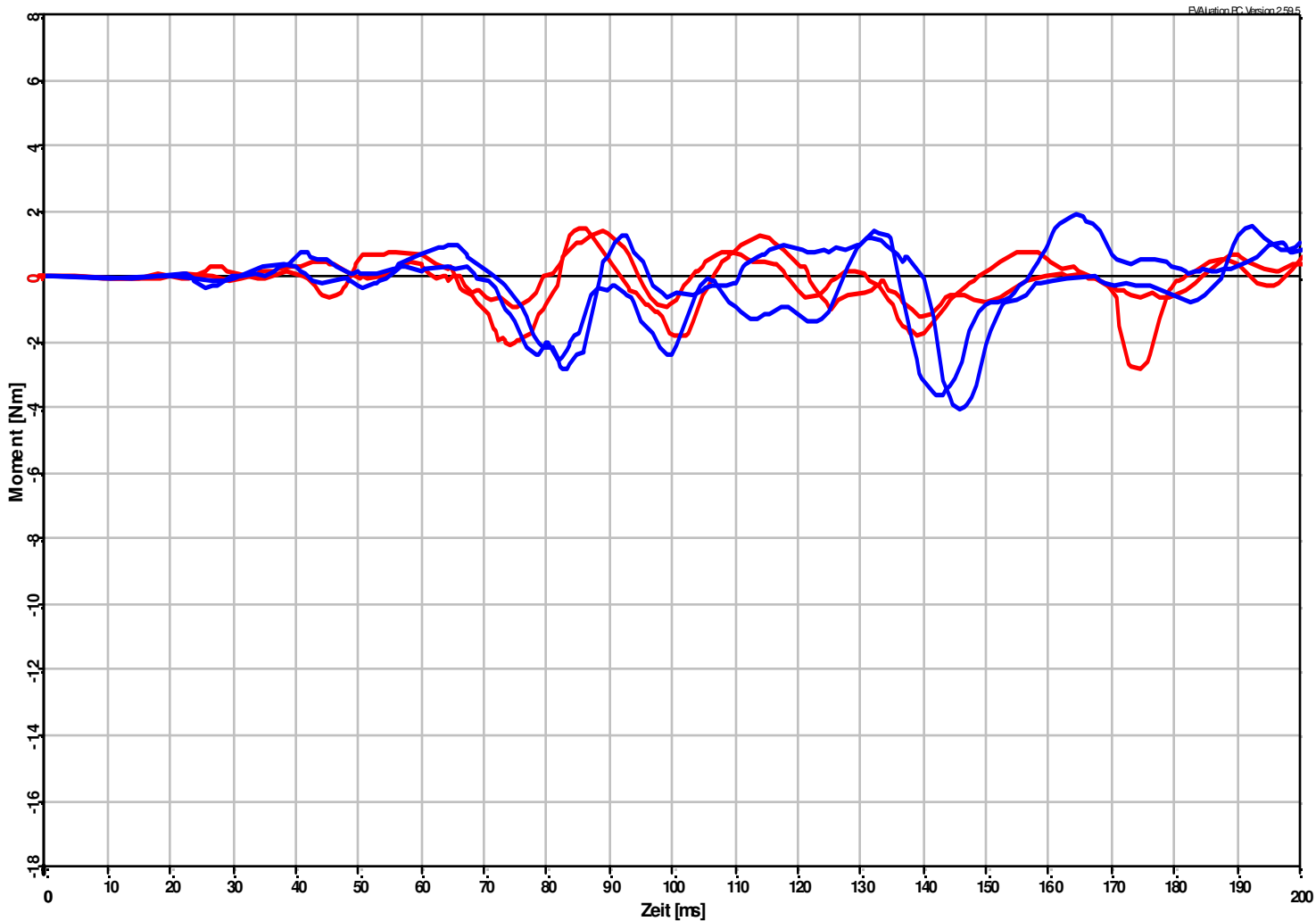
Kurvenvergleich Nr. 1, S1NECKUP00BRFOYA



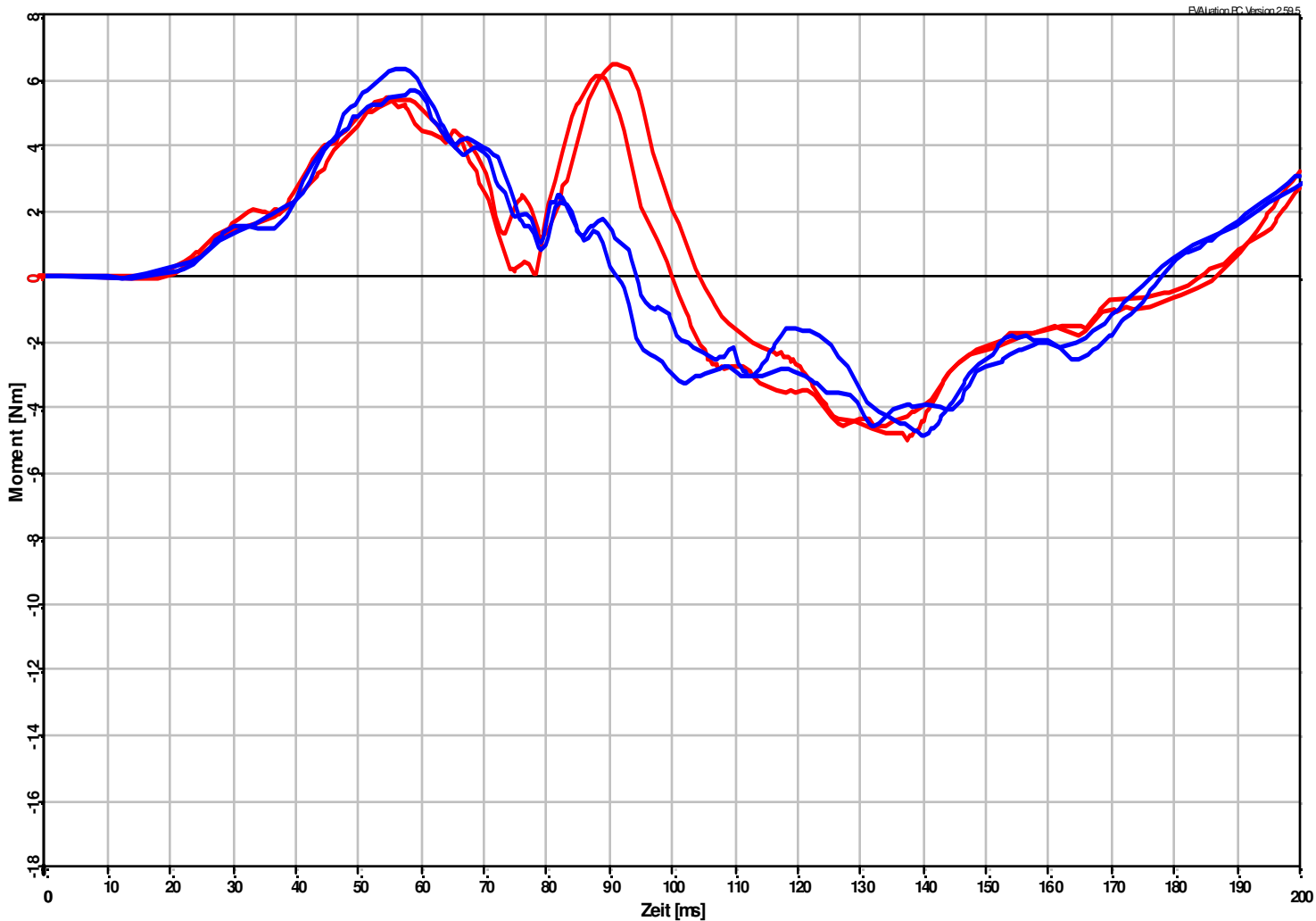
Kurvenvergleich Nr. 1, S1NECKUP00BRFOZA



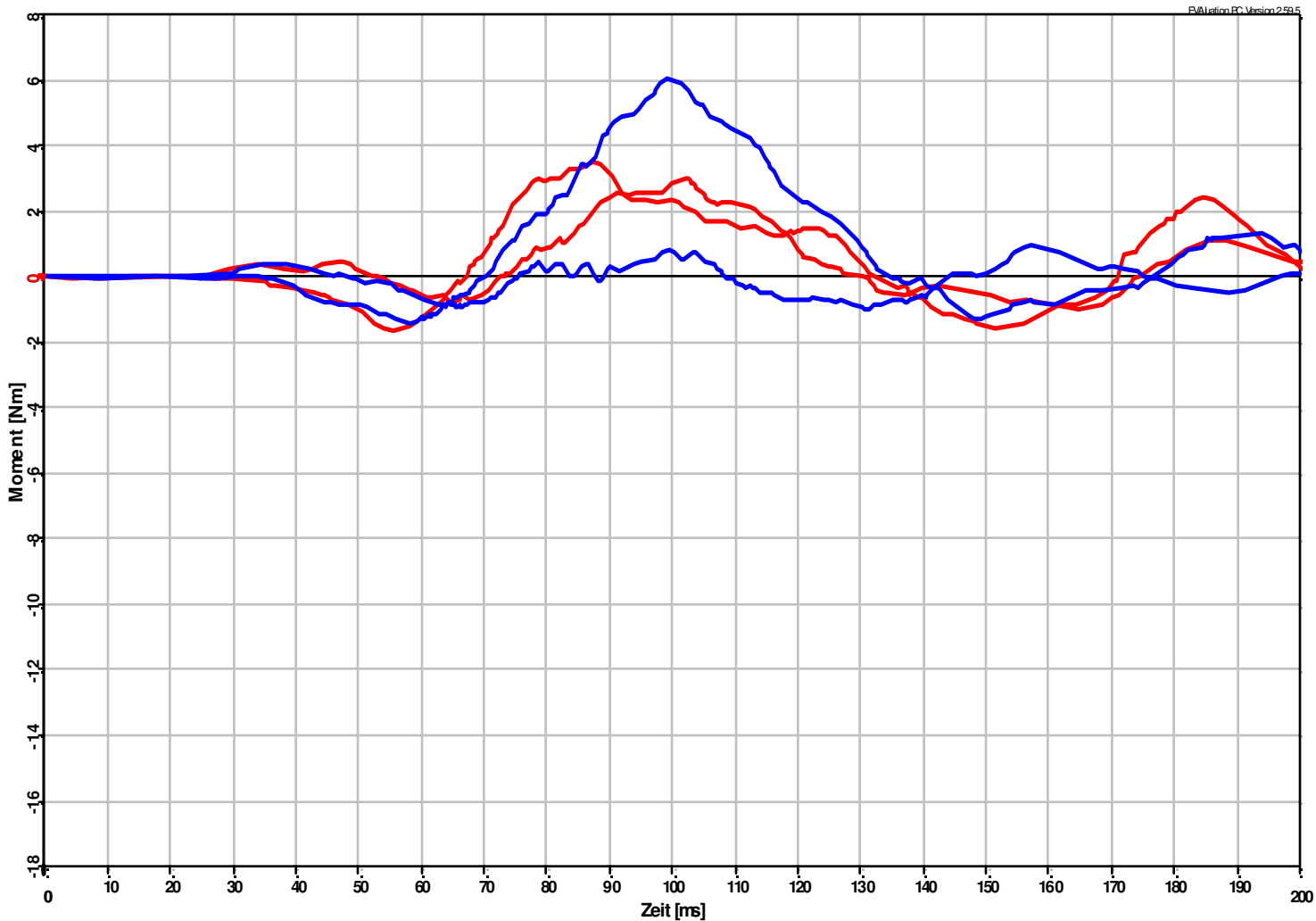
Kurvenvergleich Nr. 1, S1NECKUP00BRMOXA



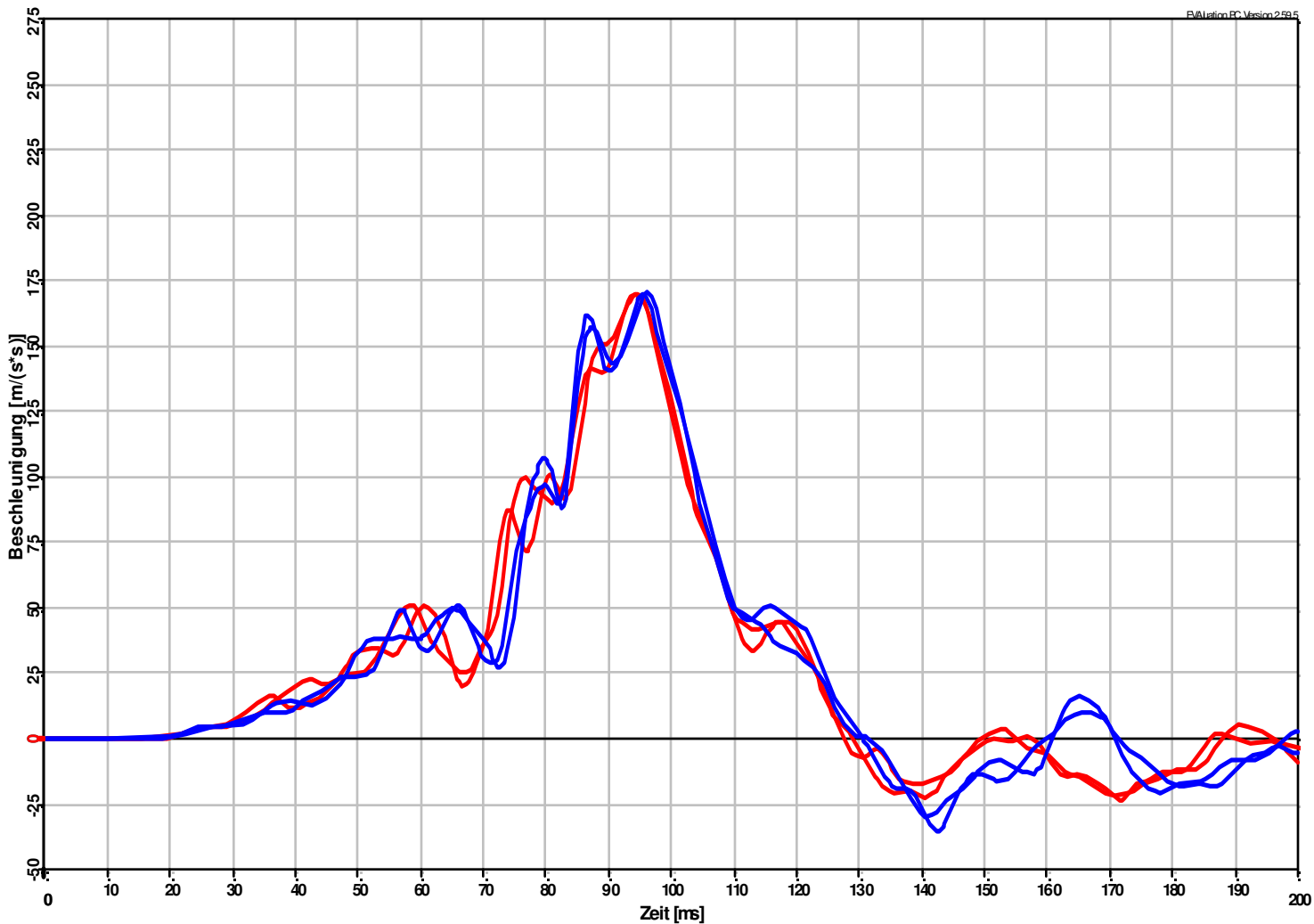
Kurvenvergleich Nr. 1, S1NECKUP00BRMOYA



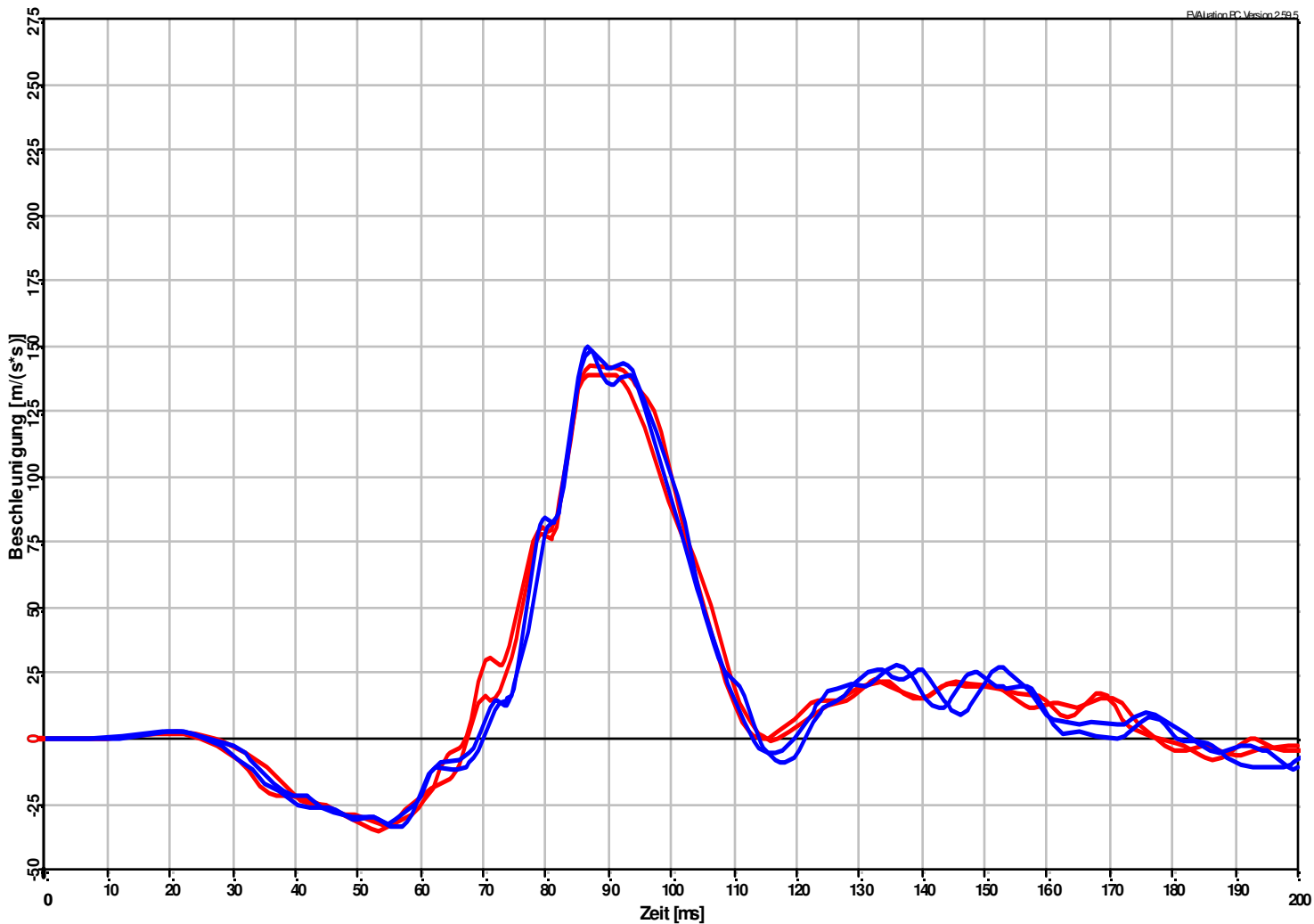
Kurvenvergleich Nr. 1, S1NECKUP00BRMOZA



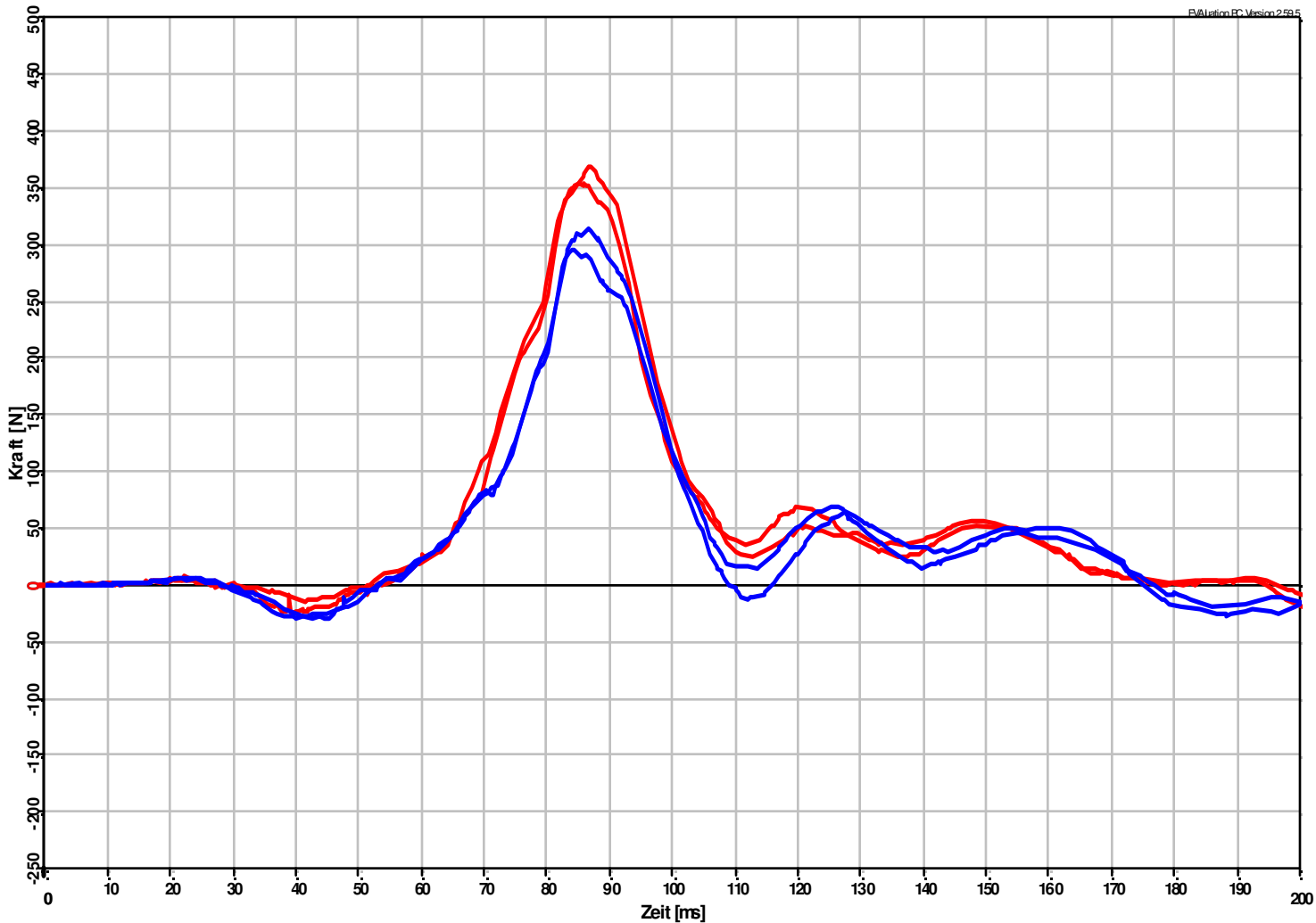
Kurvenvergleich Nr. 1, S1CESP0400BRACXA



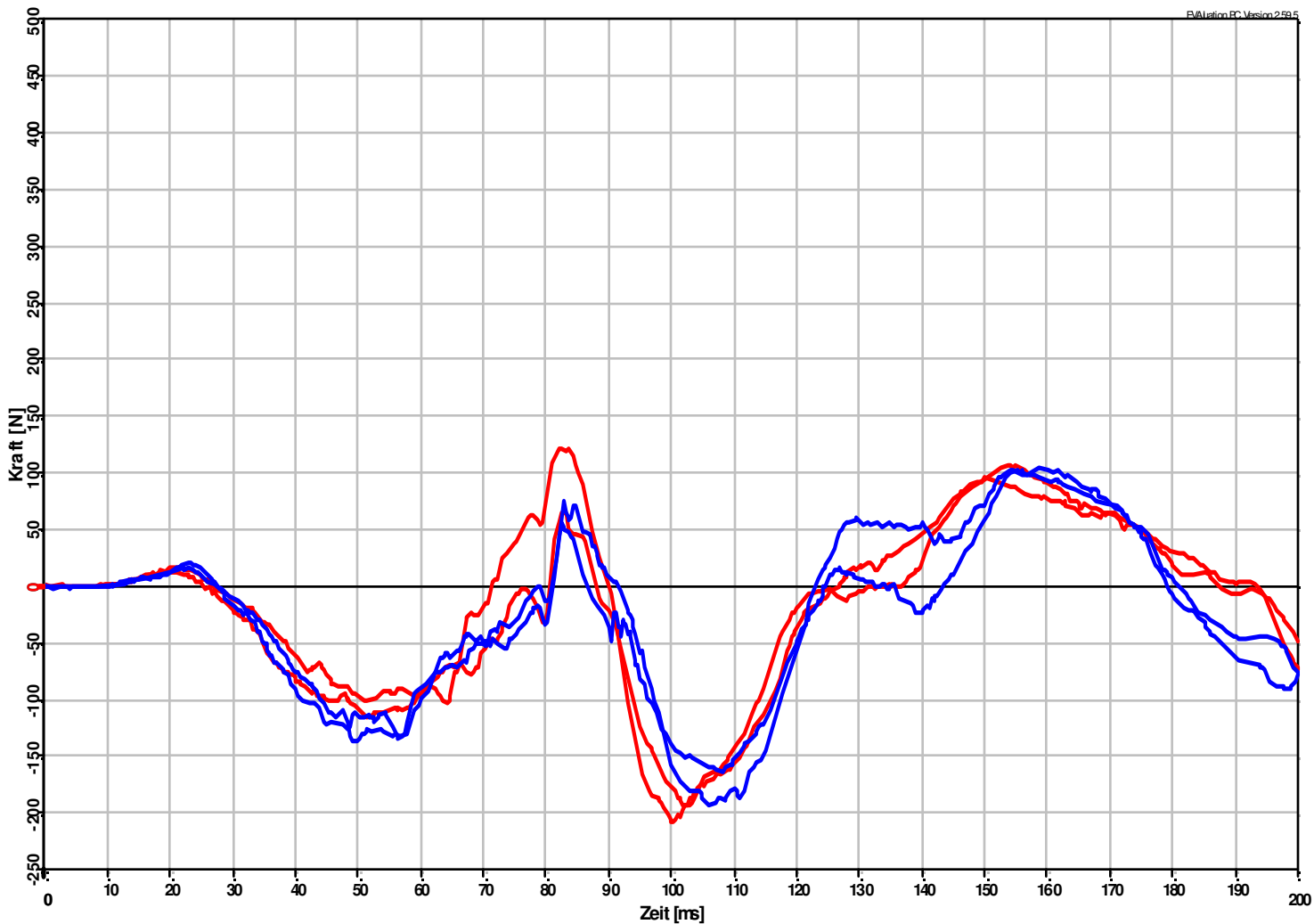
Kurvenvergleich Nr. 1, S1CESP0400BRACZA



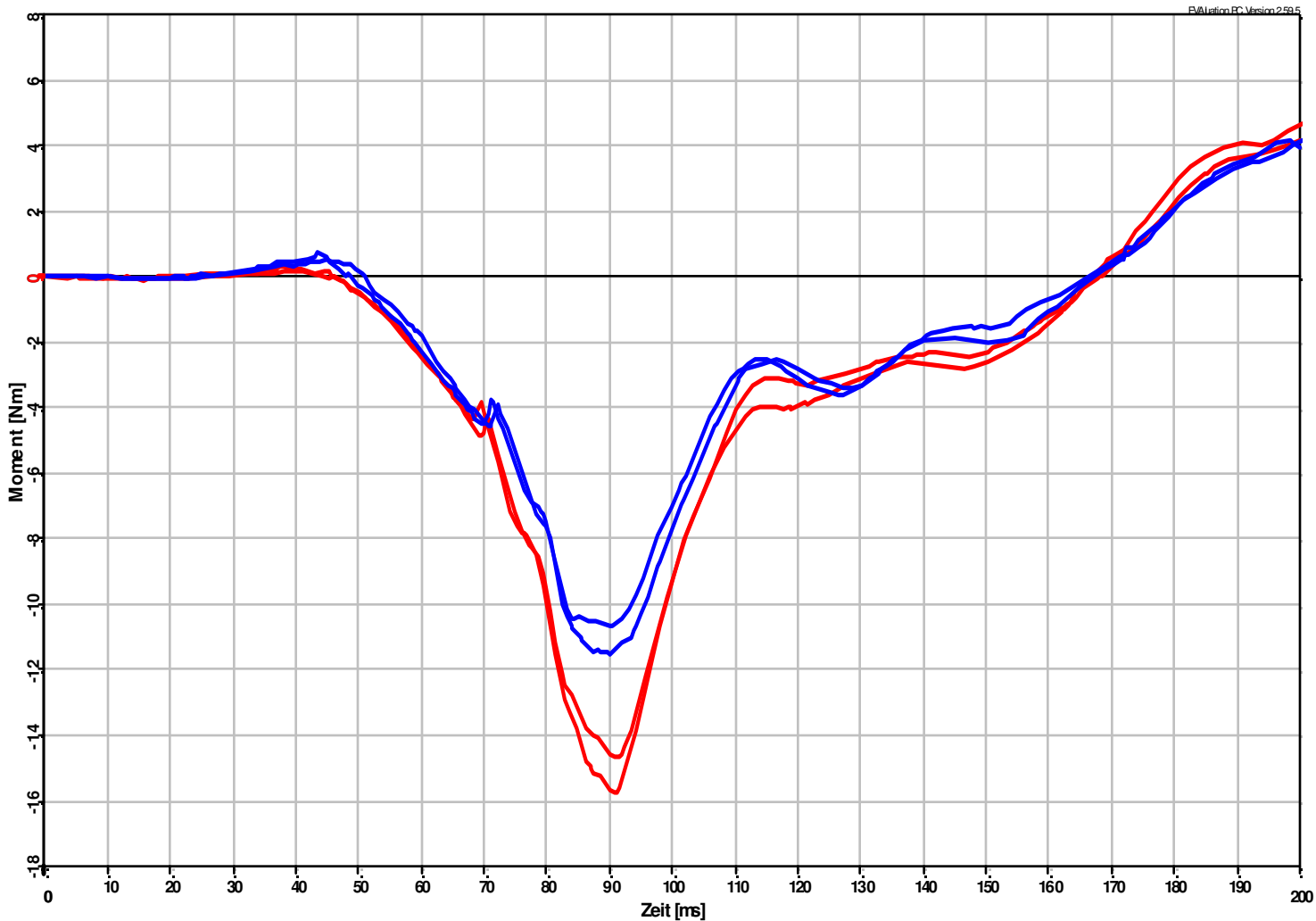
Kurvenvergleich Nr. 1, S1NECKLO00BRFOXA



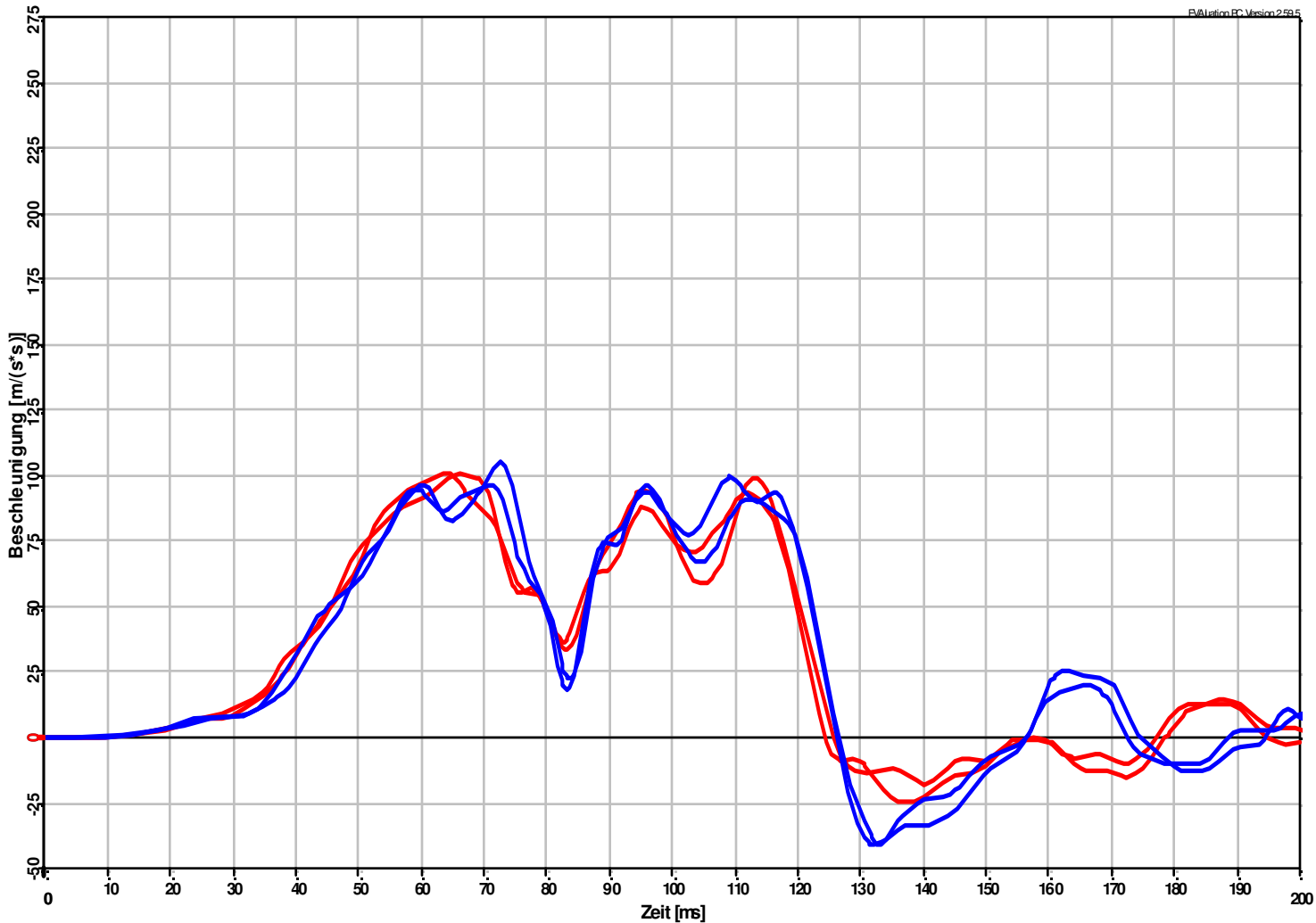
Kurvenvergleich Nr. 1, S1NECKLO00BRFOZA



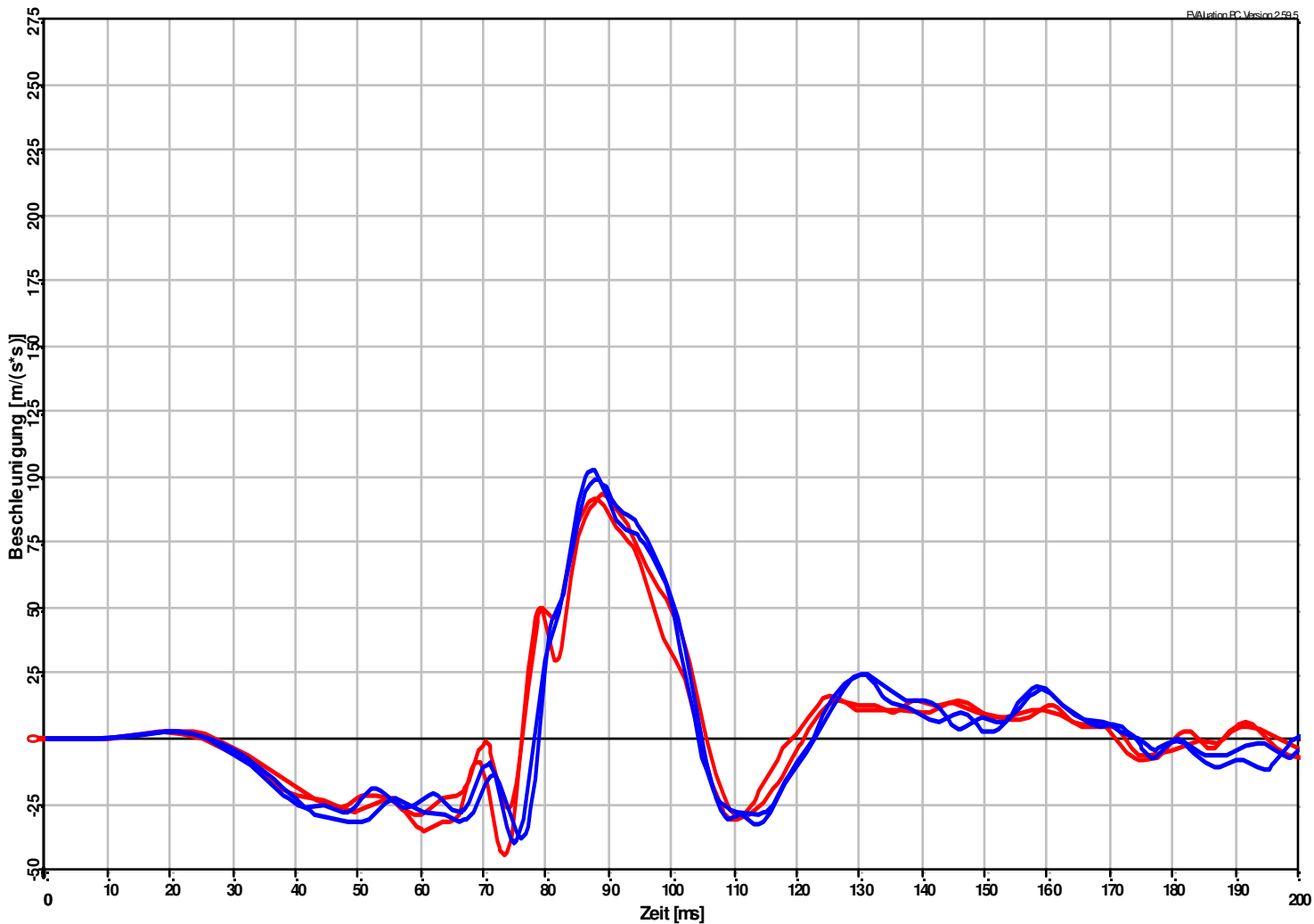
Kurvenvergleich Nr. 1, S1NECKLO00BRMOYA



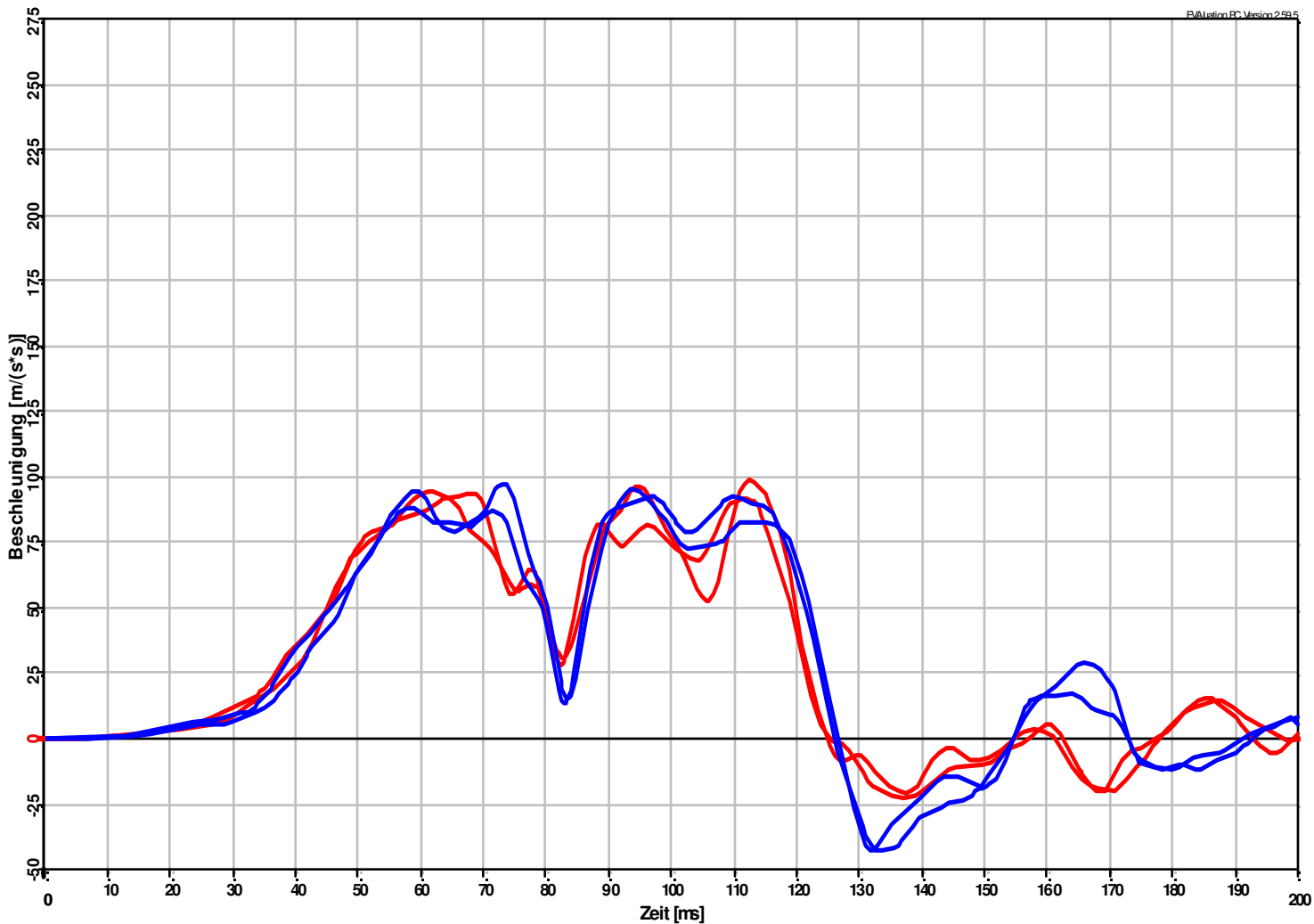
Kurvenvergleich Nr. 1, S1THSP0100BRACXA



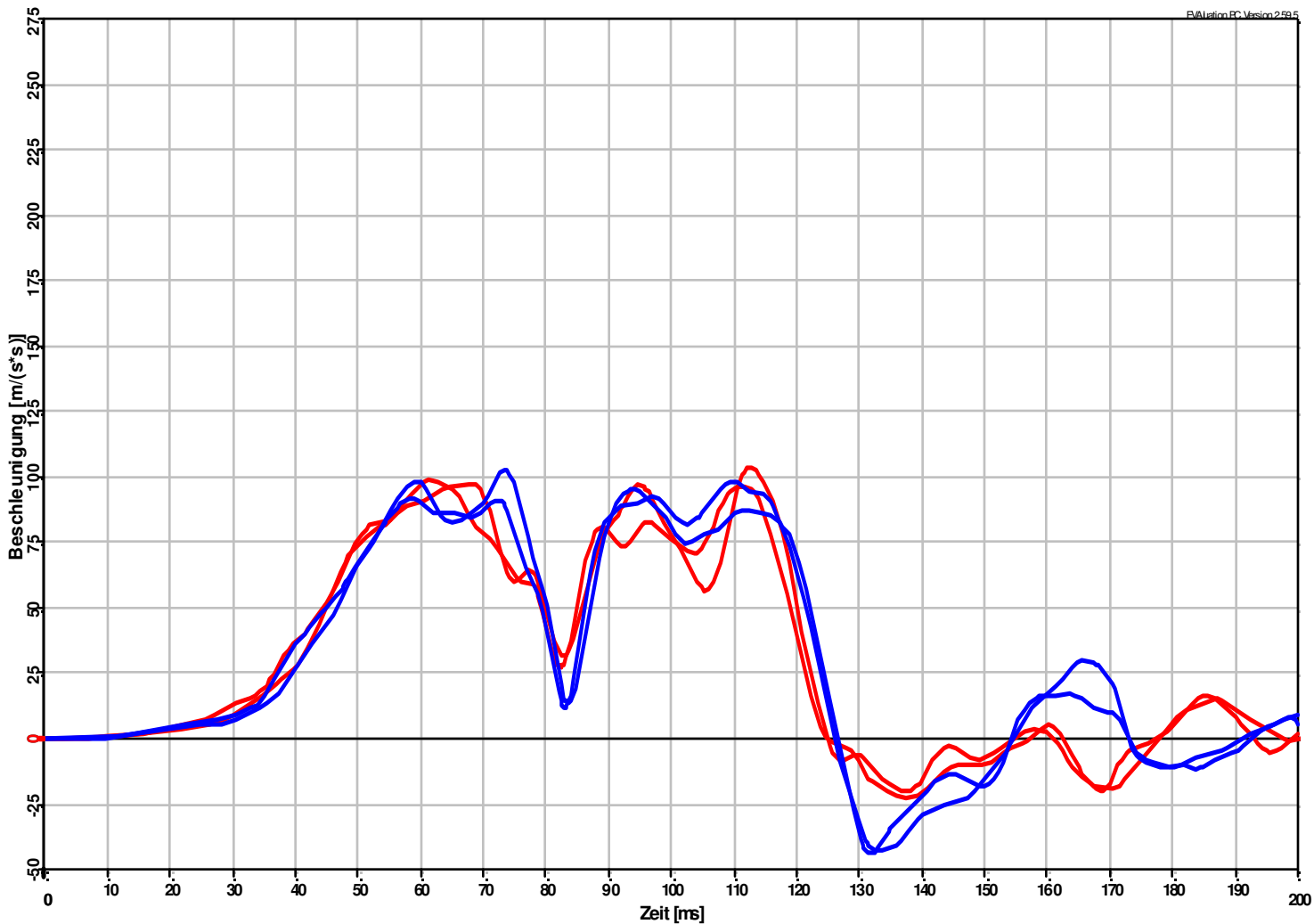
Kurvenvergleich Nr. 1, S1THSP0100BRACZA



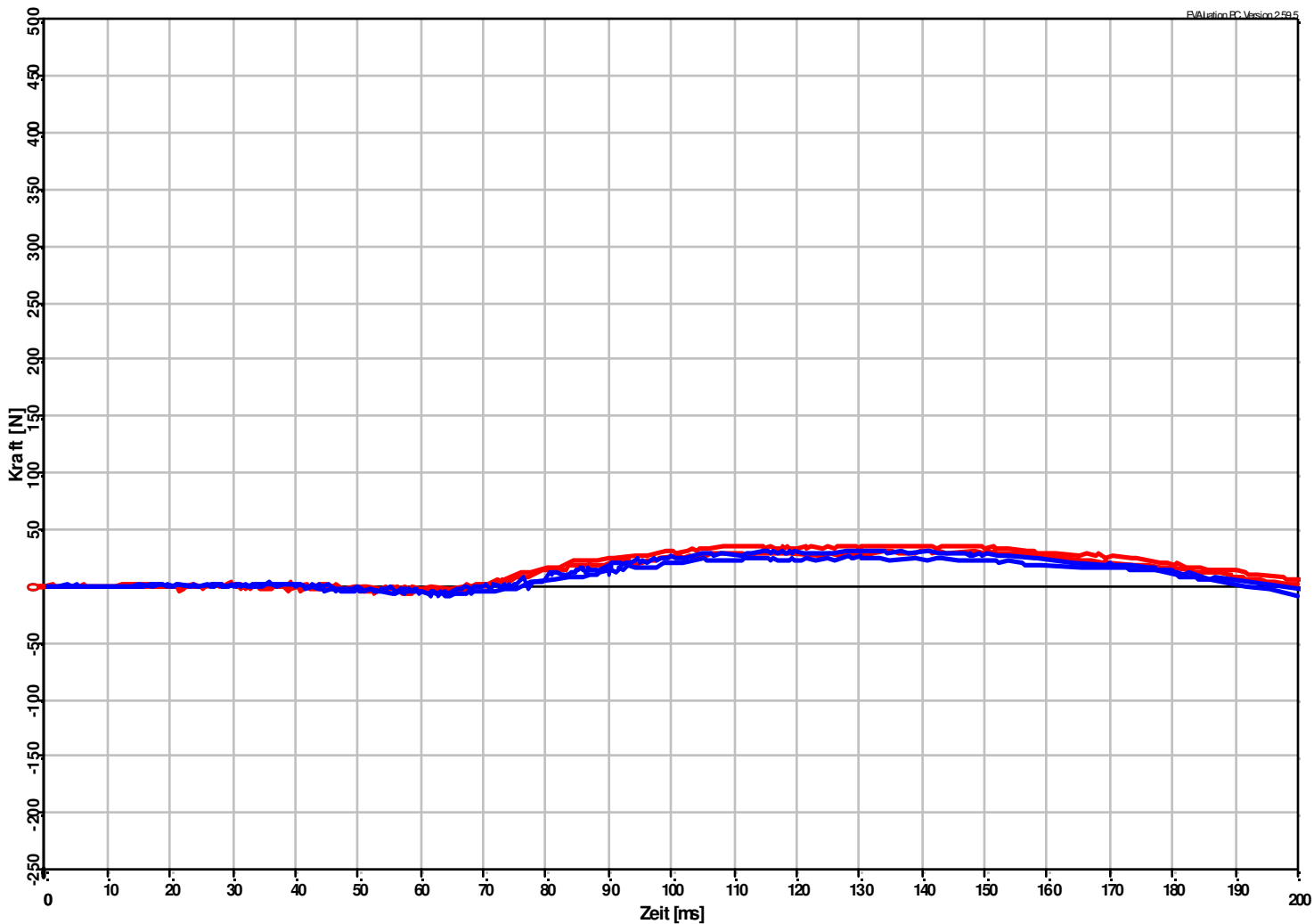
Kurvenvergleich Nr. 1, S1THSP01RDBRACXA



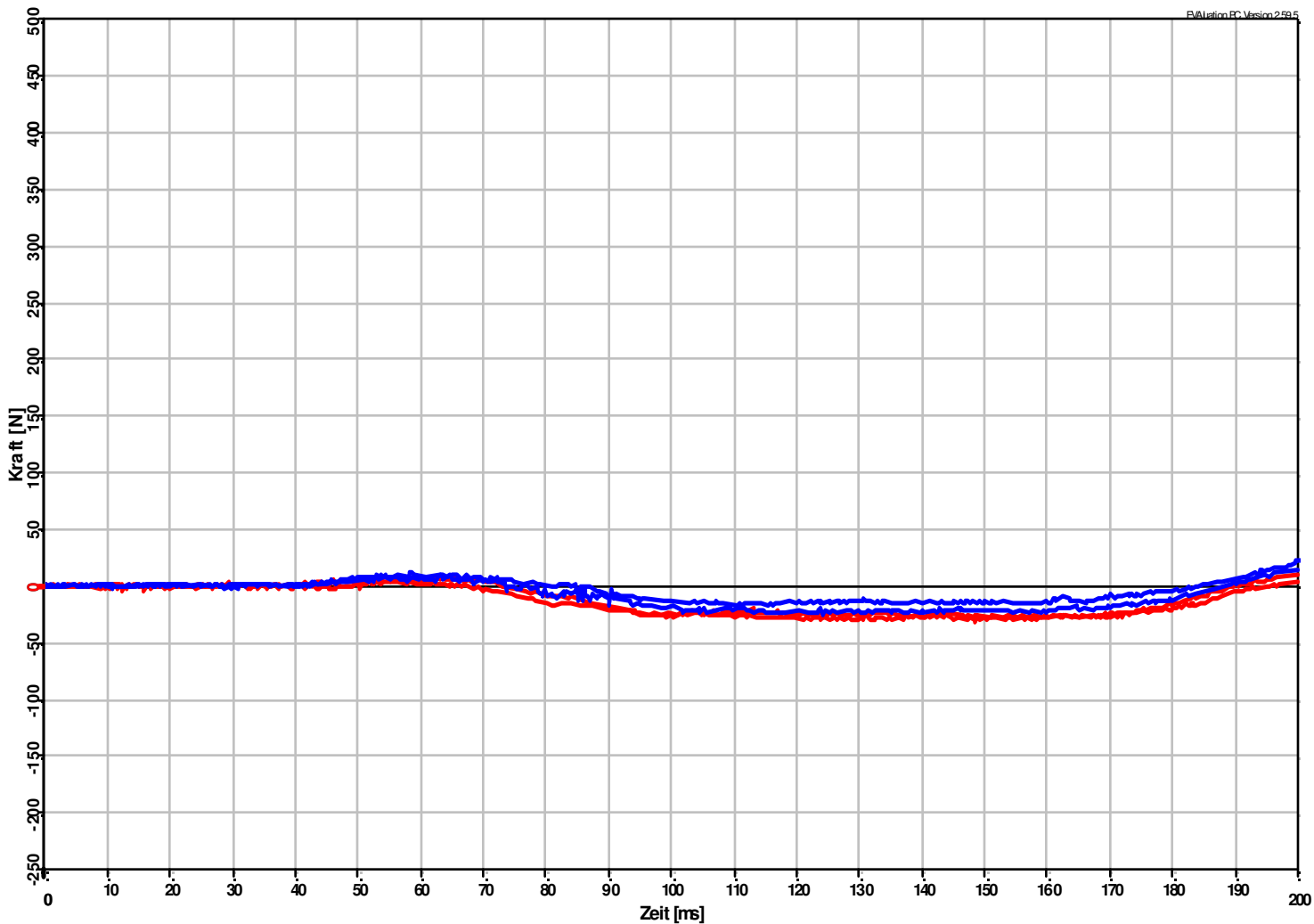
Kurvenvergleich Nr. 1, S1THSP01R2BRACXA



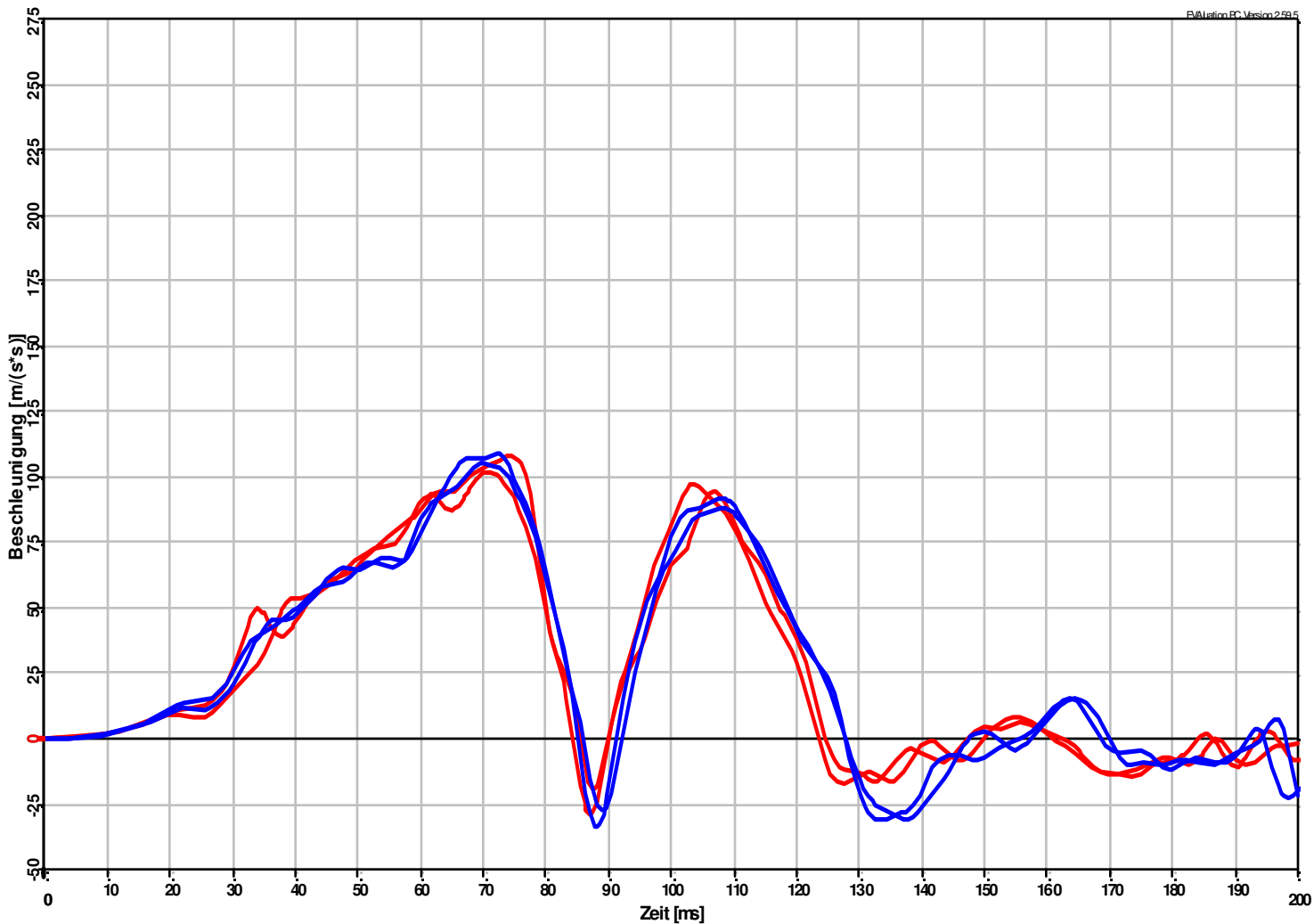
Kurvenvergleich Nr. 1, S1MUSUFR00BRFO0A



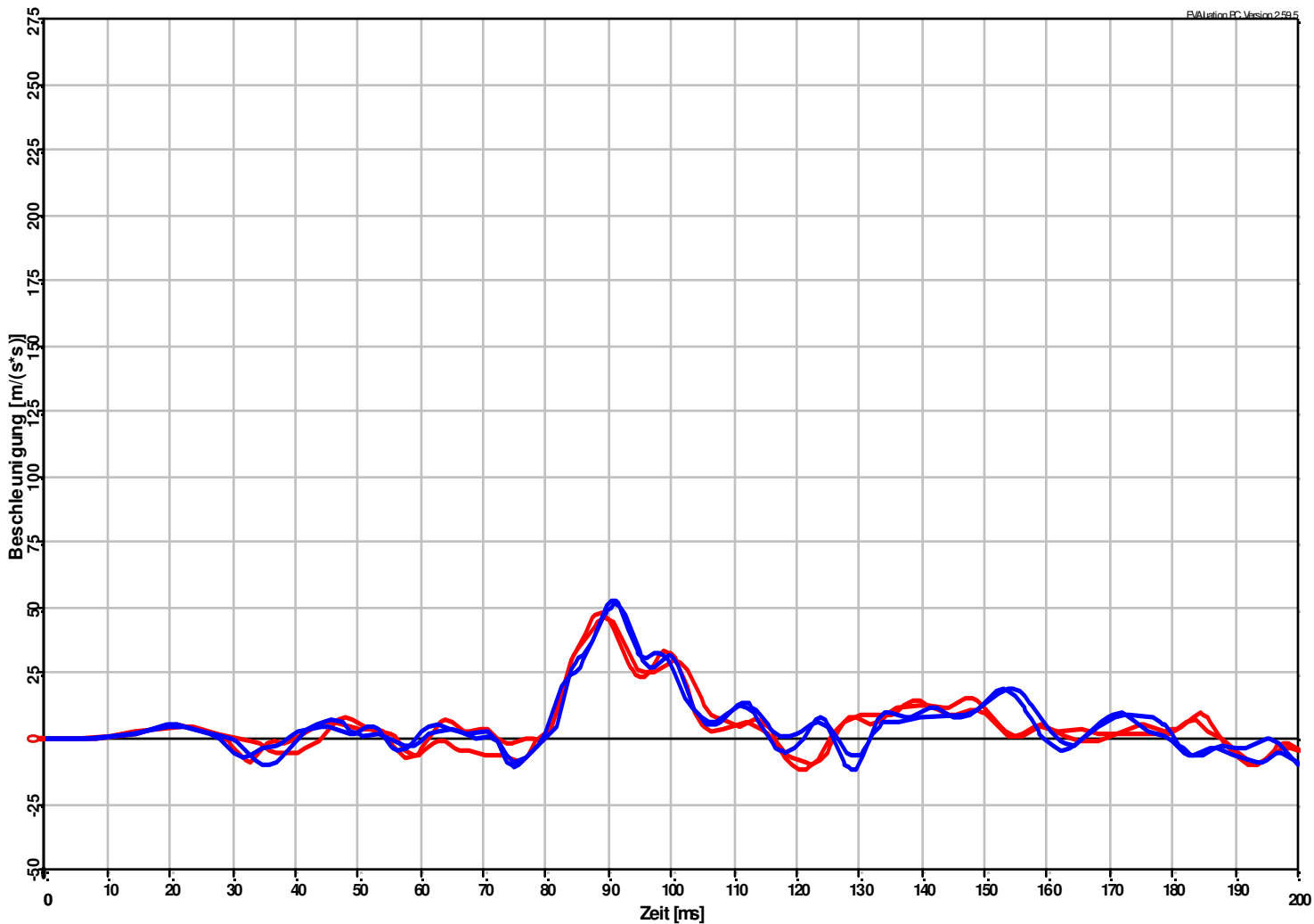
Kurvenvergleich Nr. 1, S1MUSURE00BRFO0A



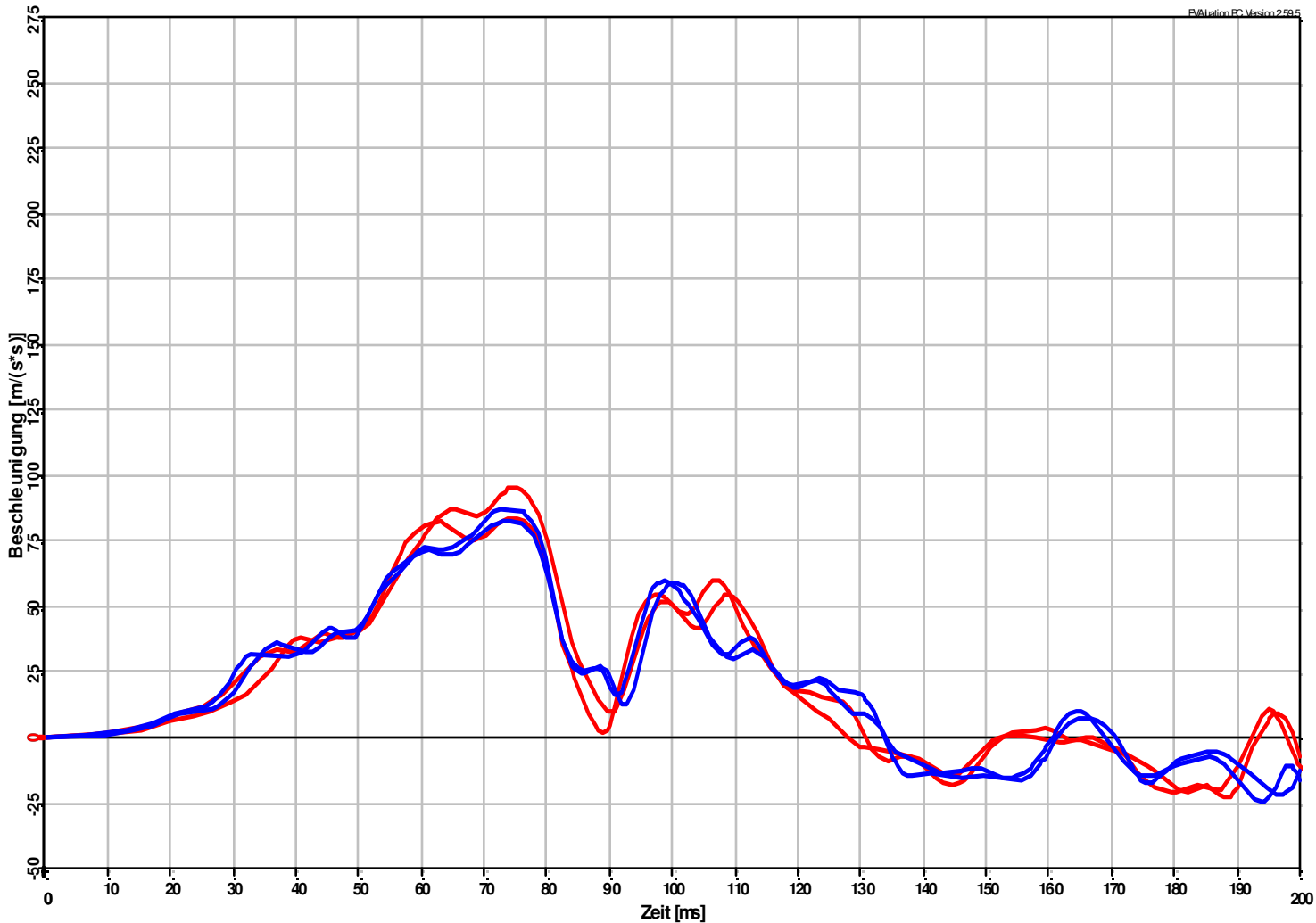
Kurvenvergleich Nr. 1, S1THSP0800BRACXA



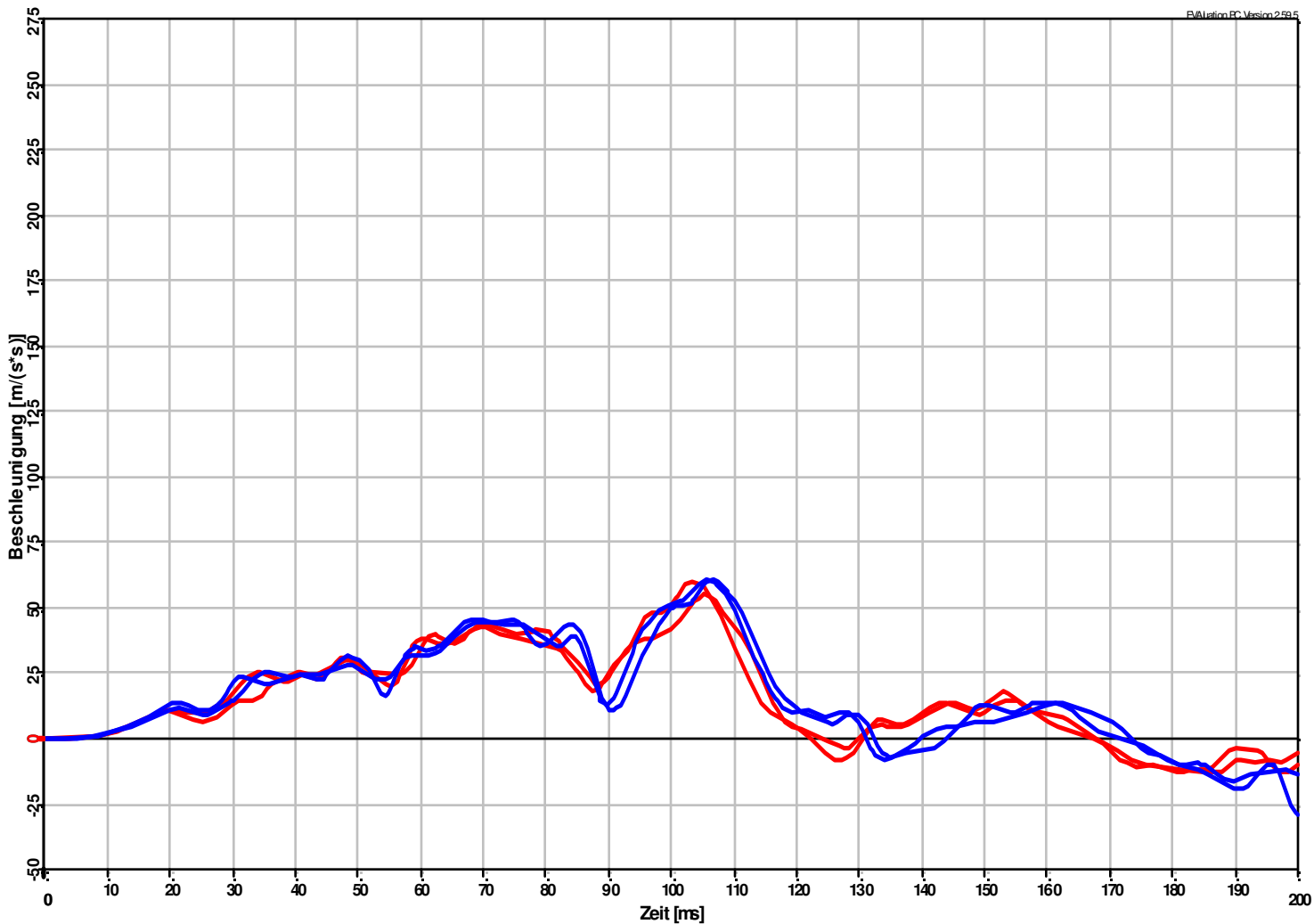
Kurvenvergleich Nr. 1, S1THSP0800BRACZA



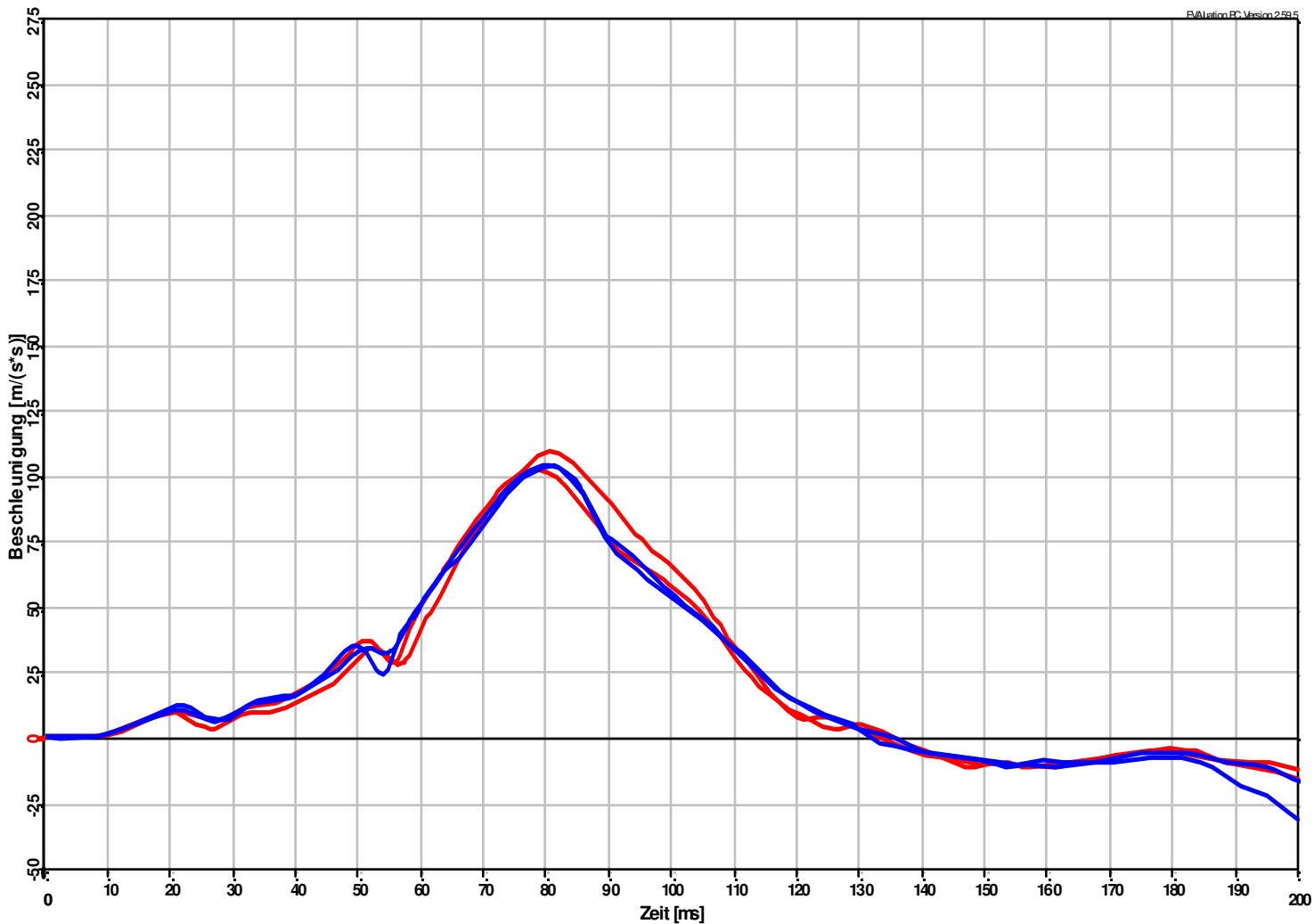
Kurvenvergleich Nr. 1, S1LUSP0100BRACXA



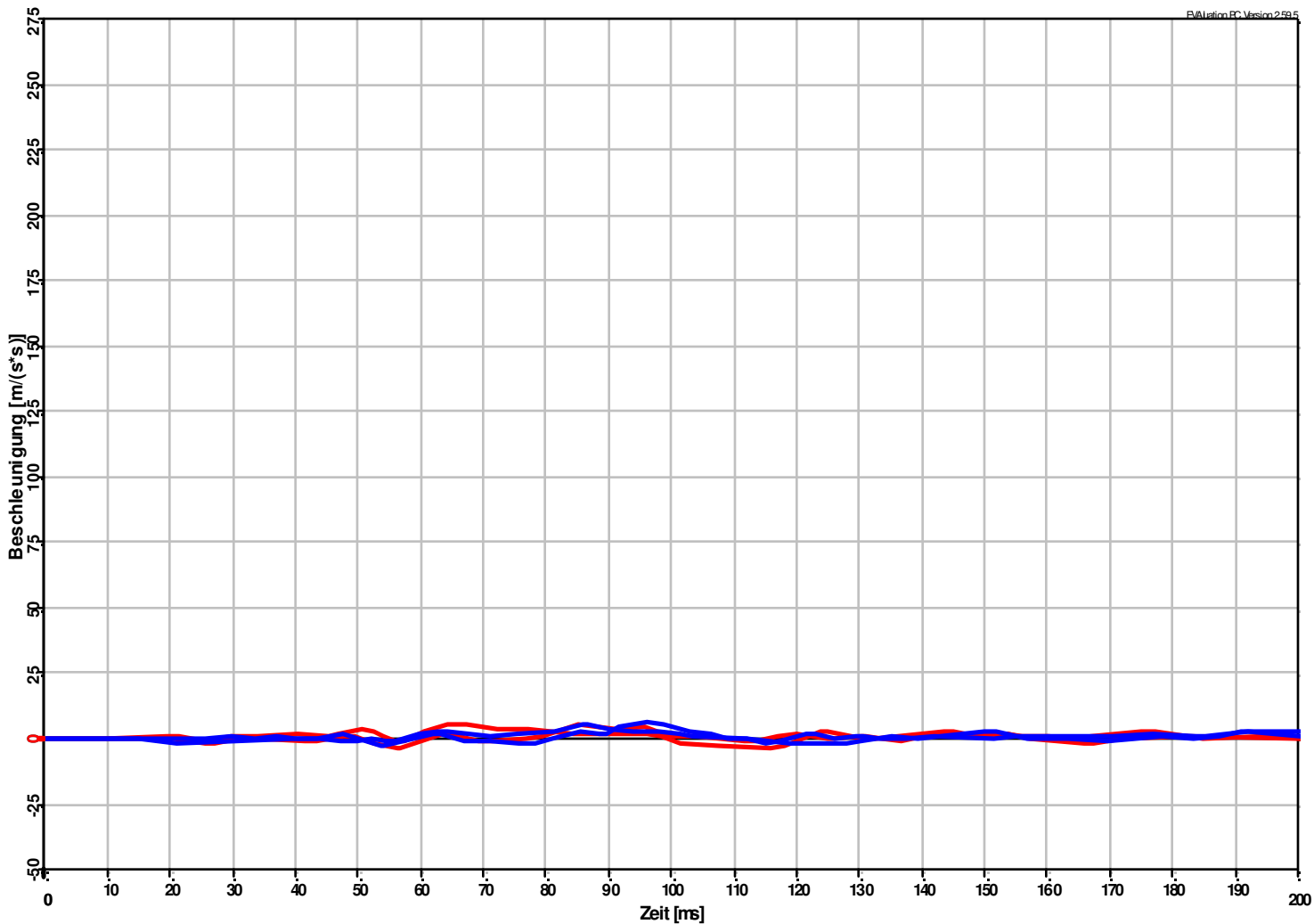
Kurvenvergleich Nr. 1, S1LUSP0100BRACZA



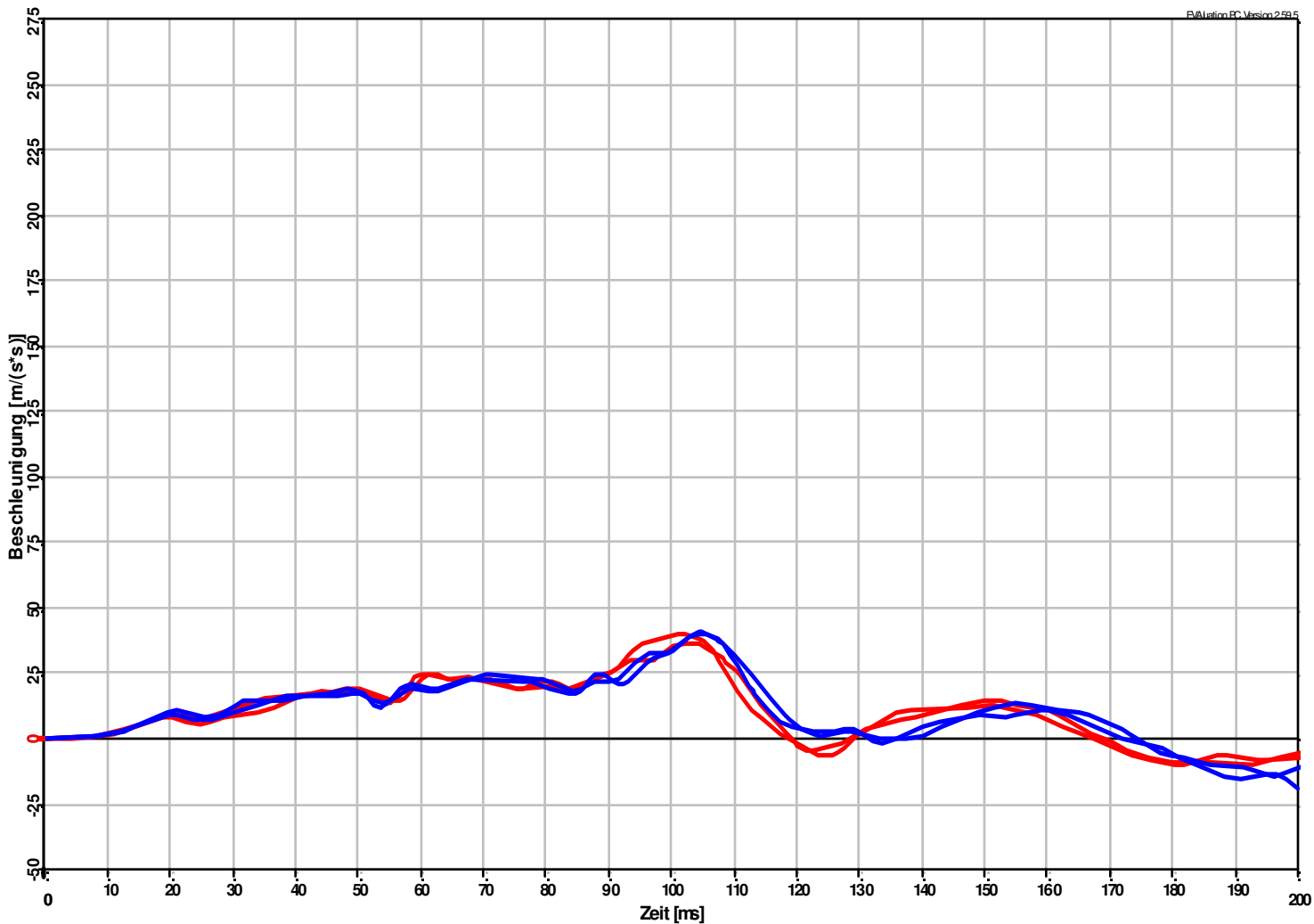
Kurvenvergleich Nr. 1, S1PELV0000BRACXA



Kurvenvergleich Nr. 1, S1PELV0000BRACYA



Kurvenvergleich Nr. 1, S1PELV0000BRACZA



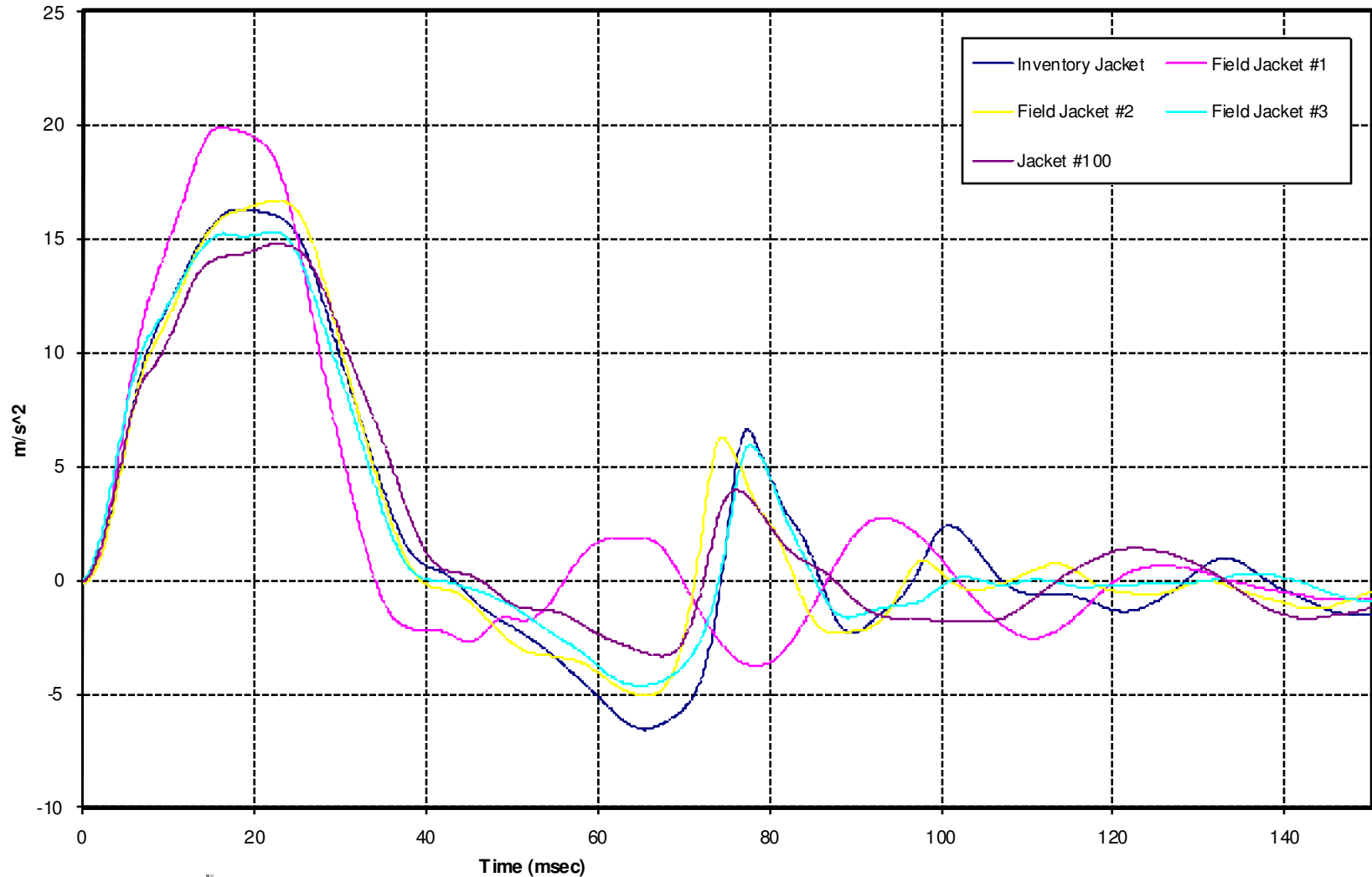
FURTHER JACKET STIFFNESS EXPERIENCE

Experience

- ▶ Humanetics Heidelberg running “certification without head restraint” test
- ▶ One dummy found with unusual performance
 - Jacket tests soft on jacket only impact test
 - Changing jacket brings dummy back to typical performance

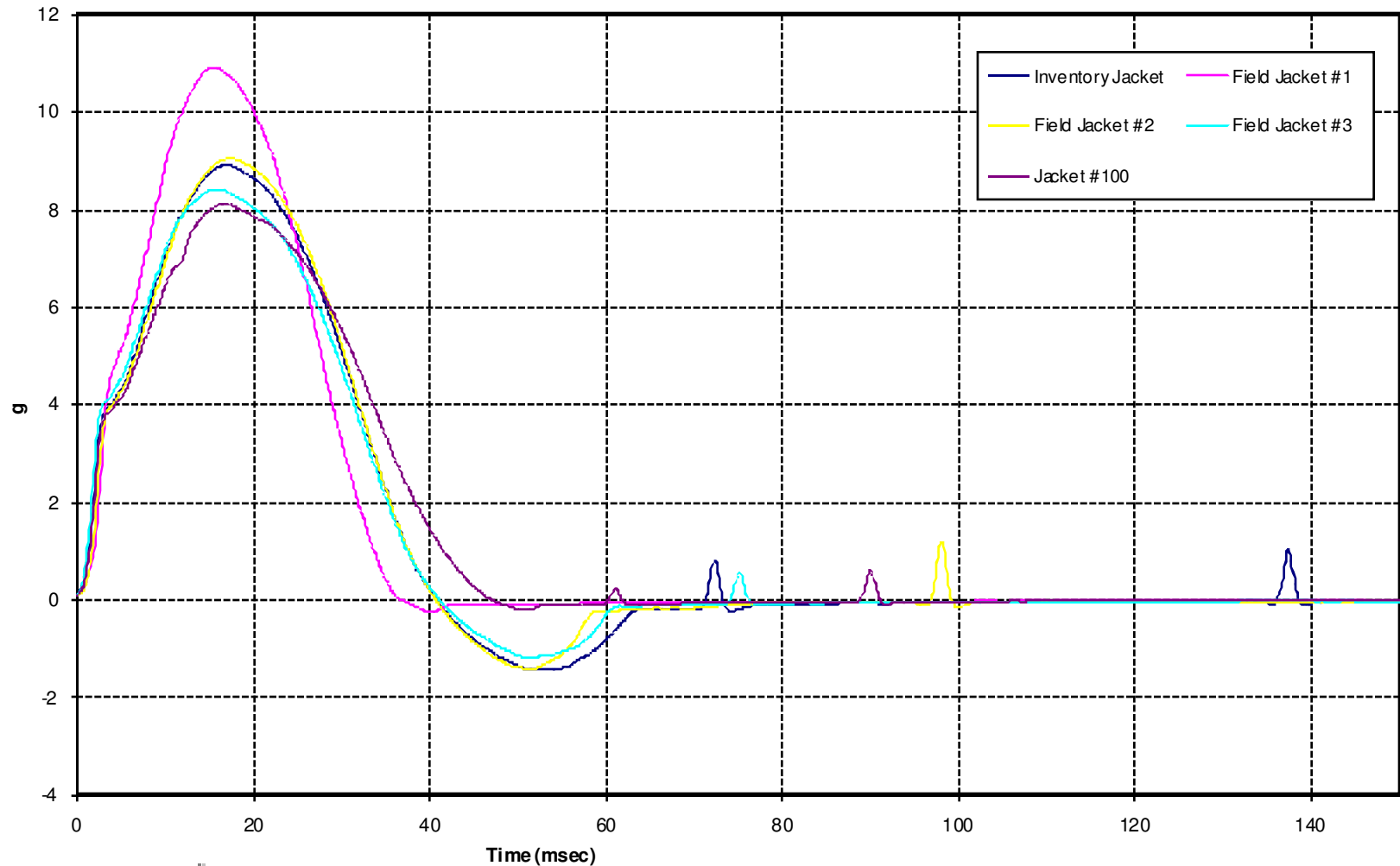
Jacket Impact Testing

Sled Acceleration



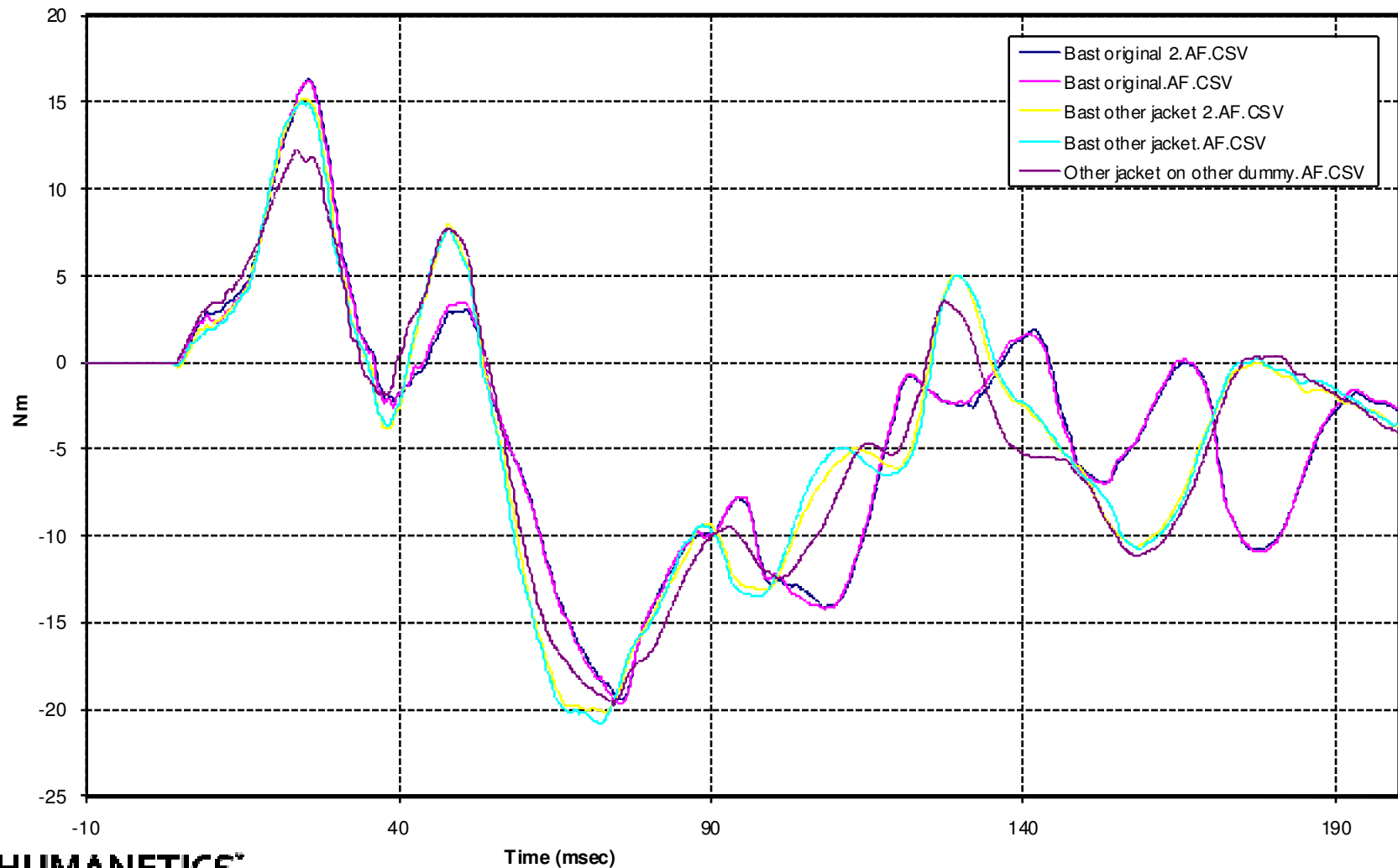
Jacket Impact Testing

Pendulum Decel.

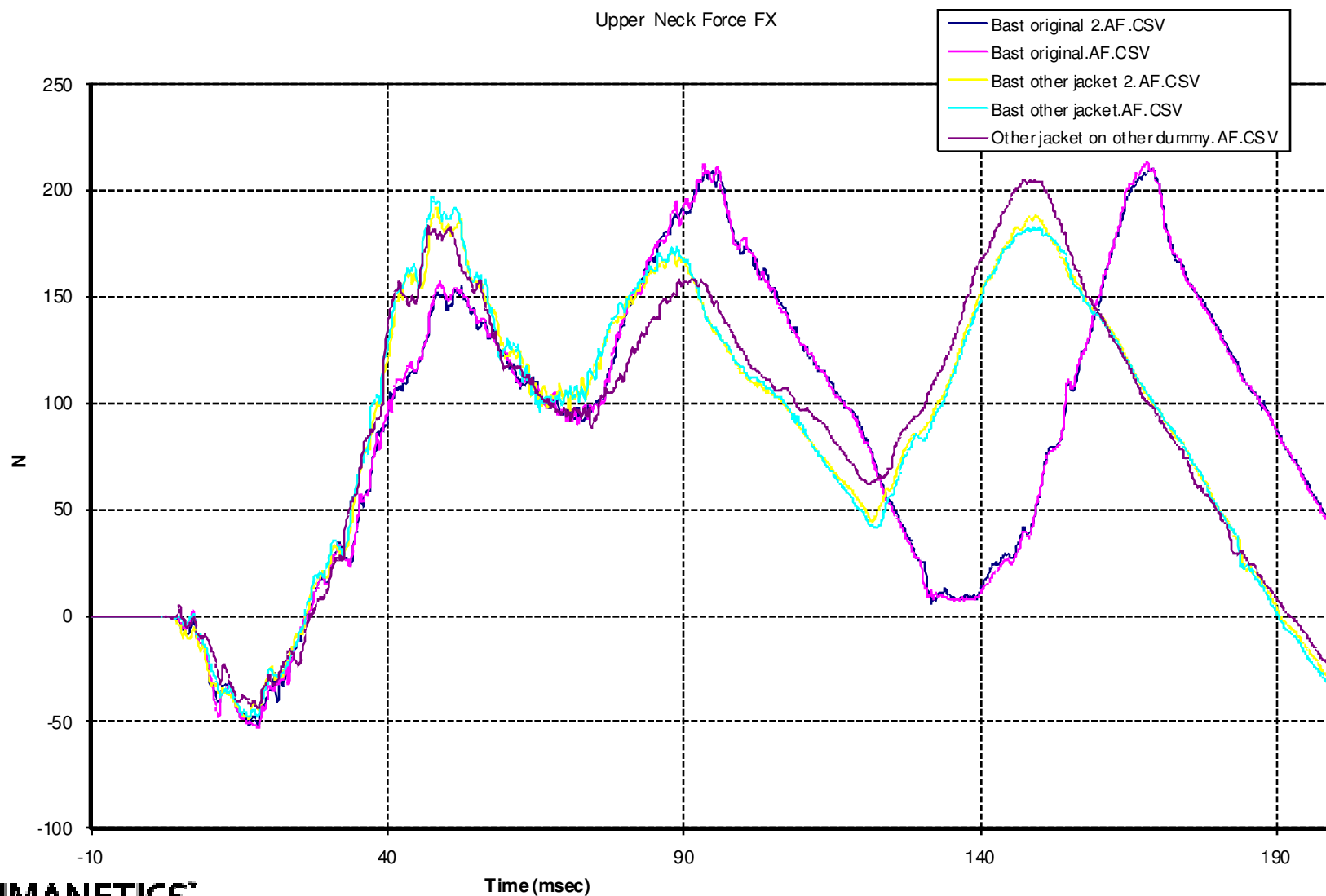


Cert. Test Jacket Comparison

Upper Neck Moment MY

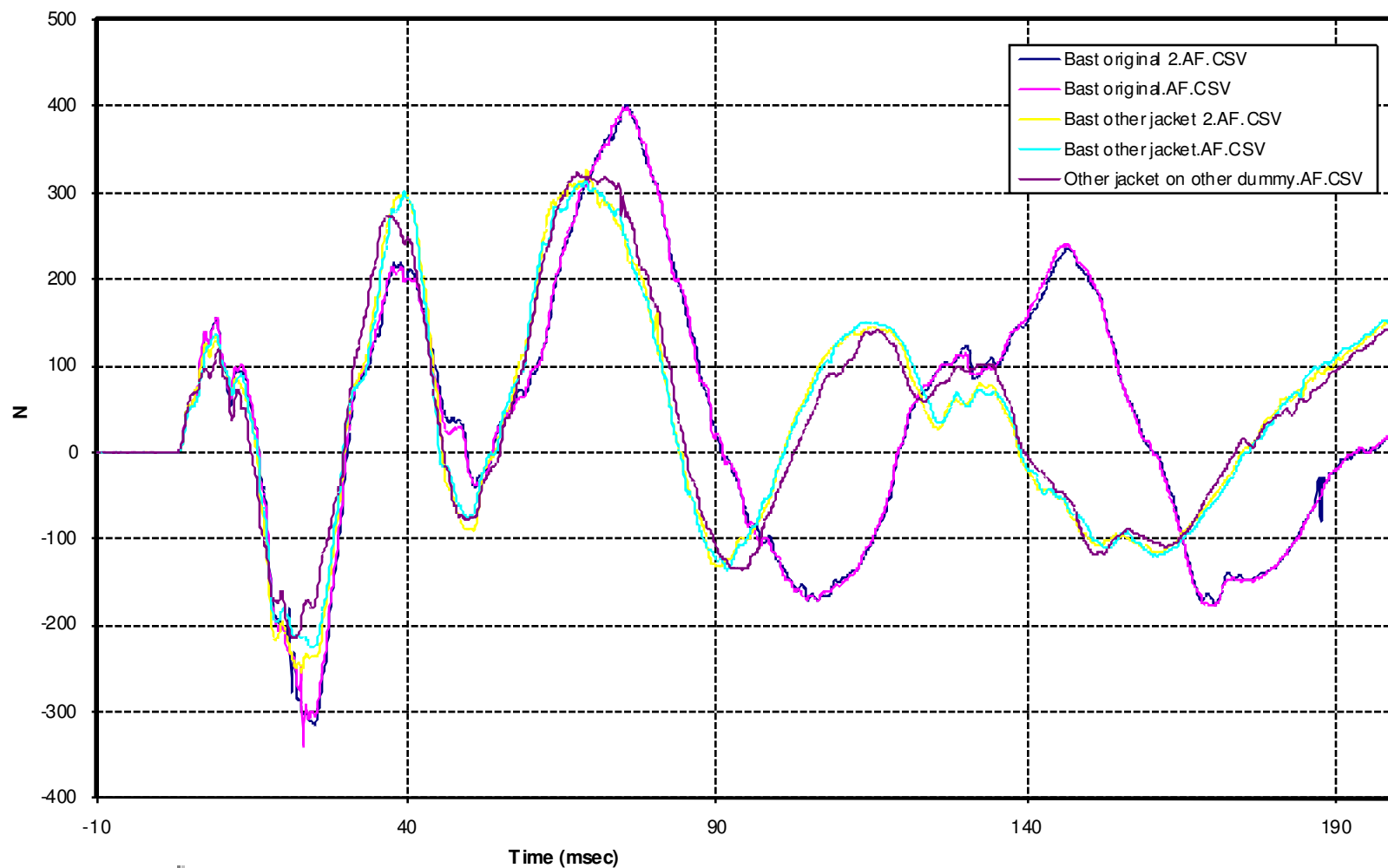


Cert. Test Jacket Comparison



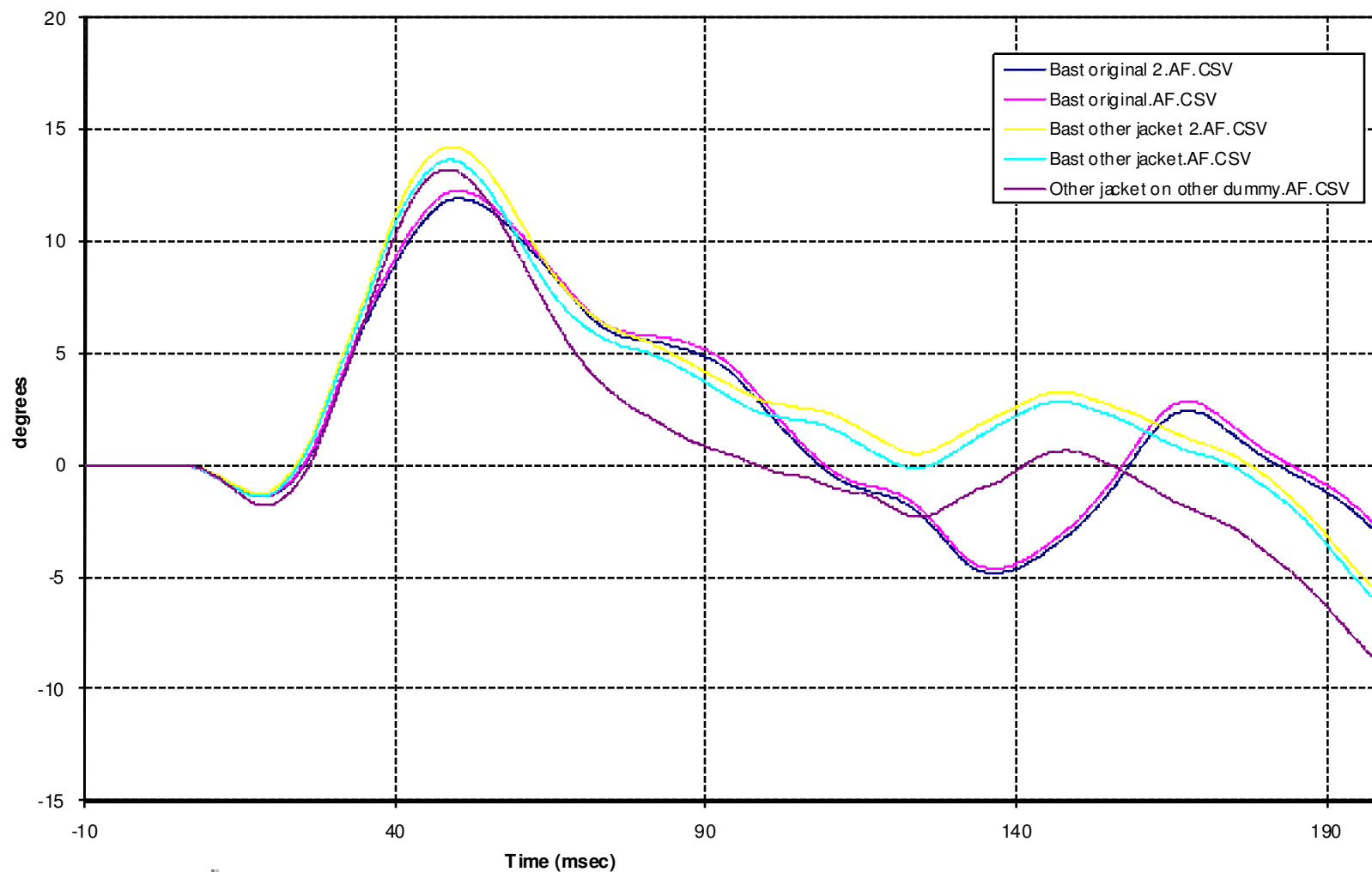
Cert. Test Jacket Comparison

Upper Neck Force FZ



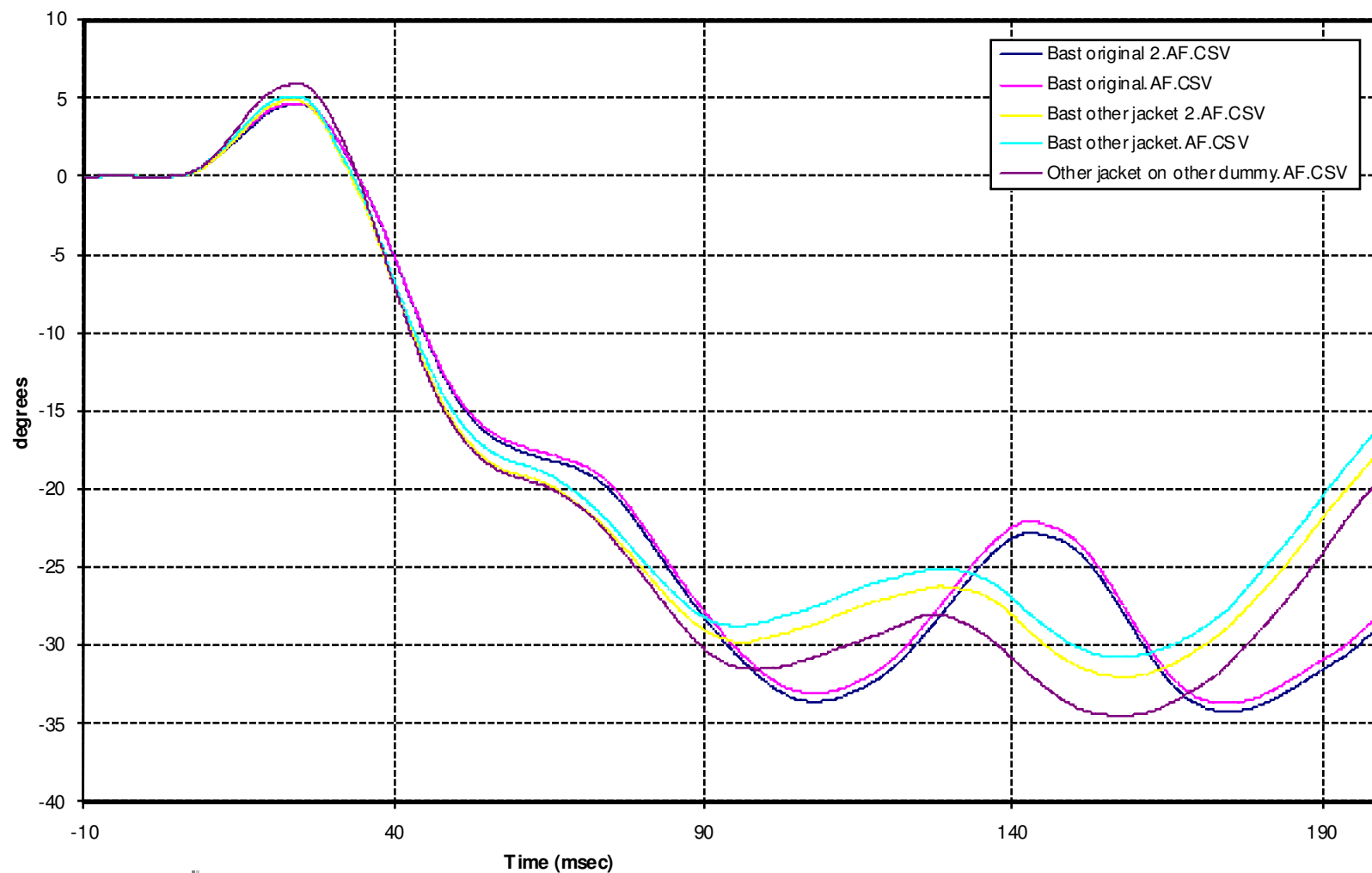
Cert. Test Jacket Comparison

Pot A - Head Rotation about OC



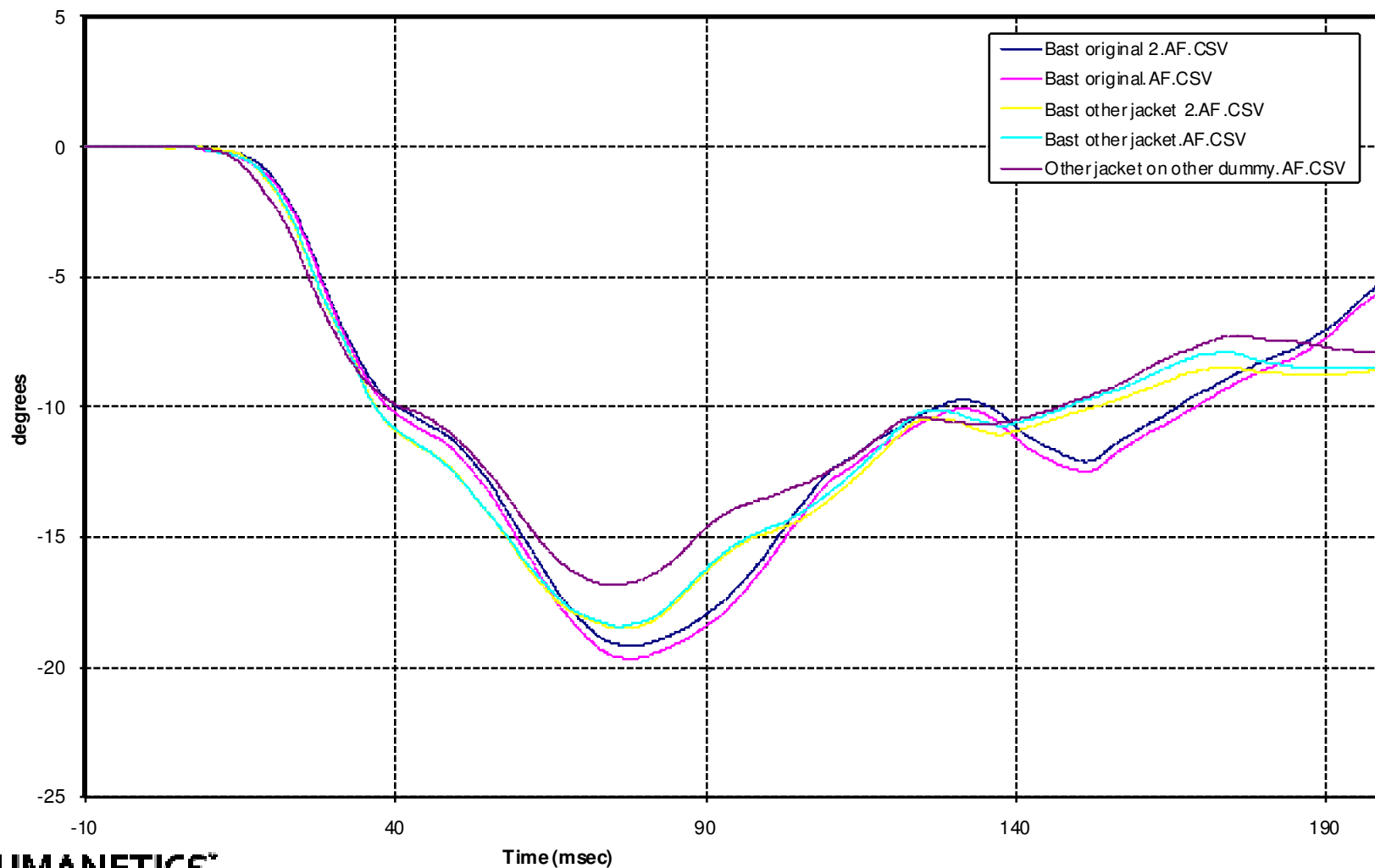
Cert. Test Jacket Comparison

Pot B - Neck Link Rotation about T1

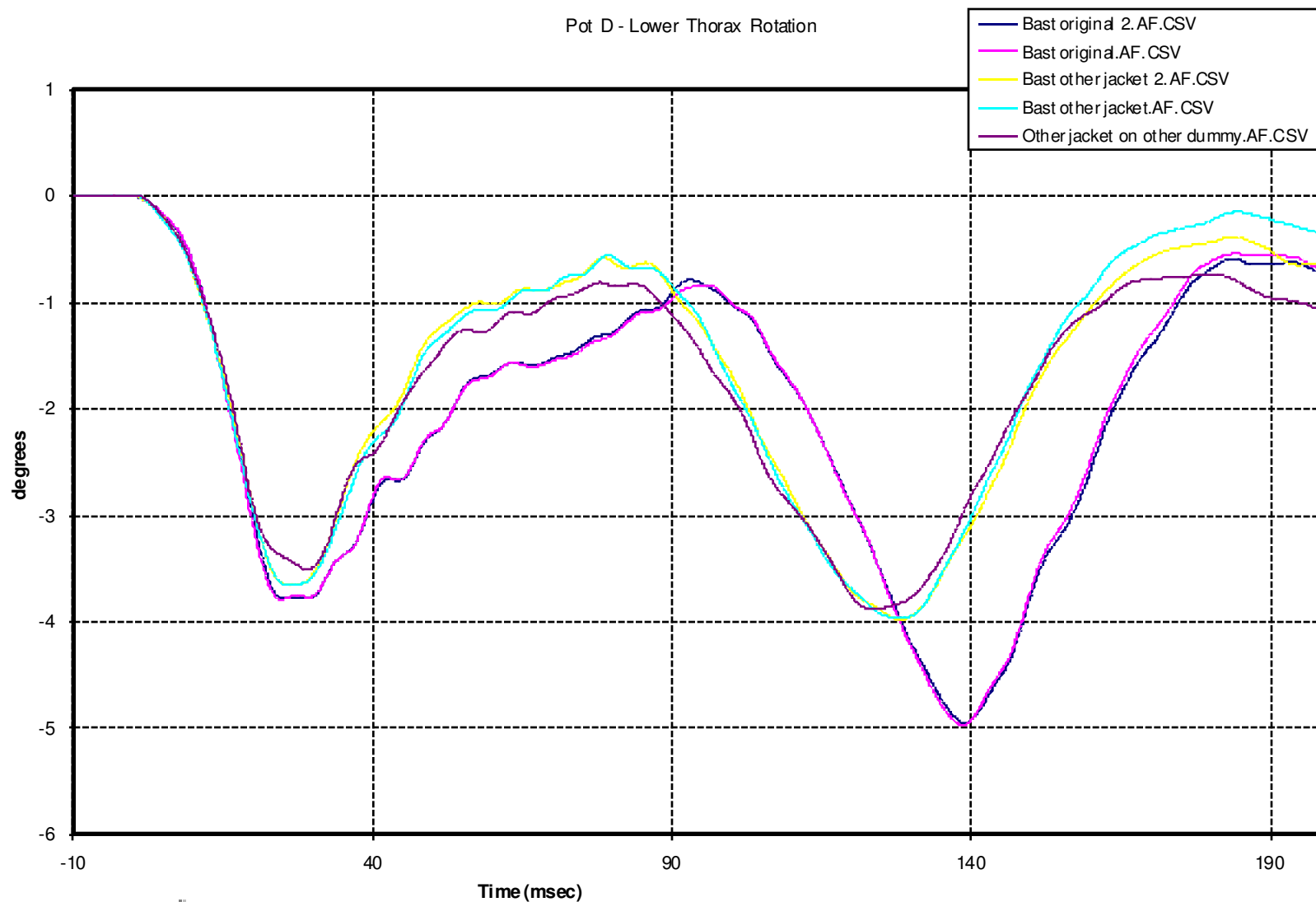


Cert. Test Jacket Comparison

Pot C - T1 Rotation

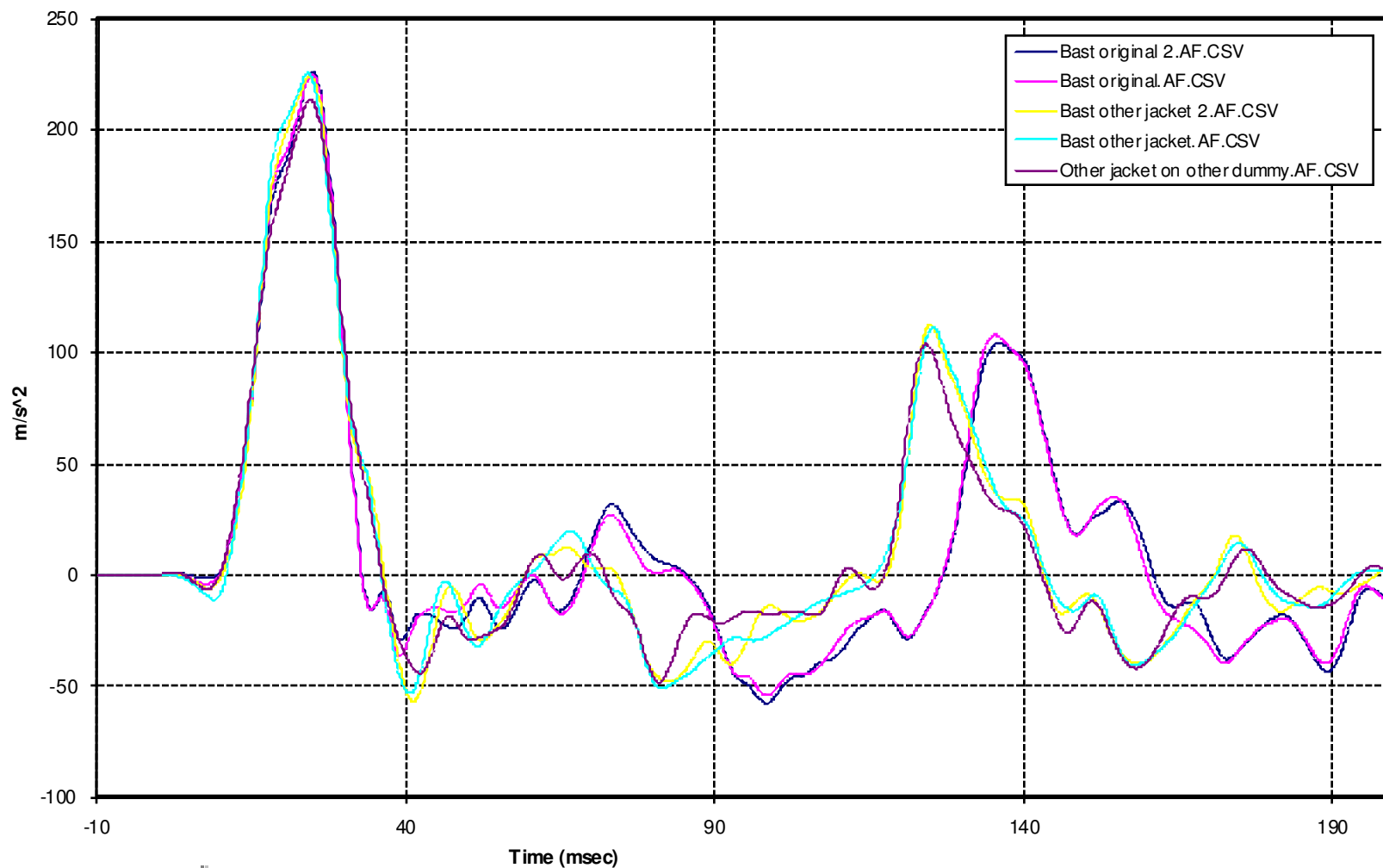


Cert. Test Jacket Comparison



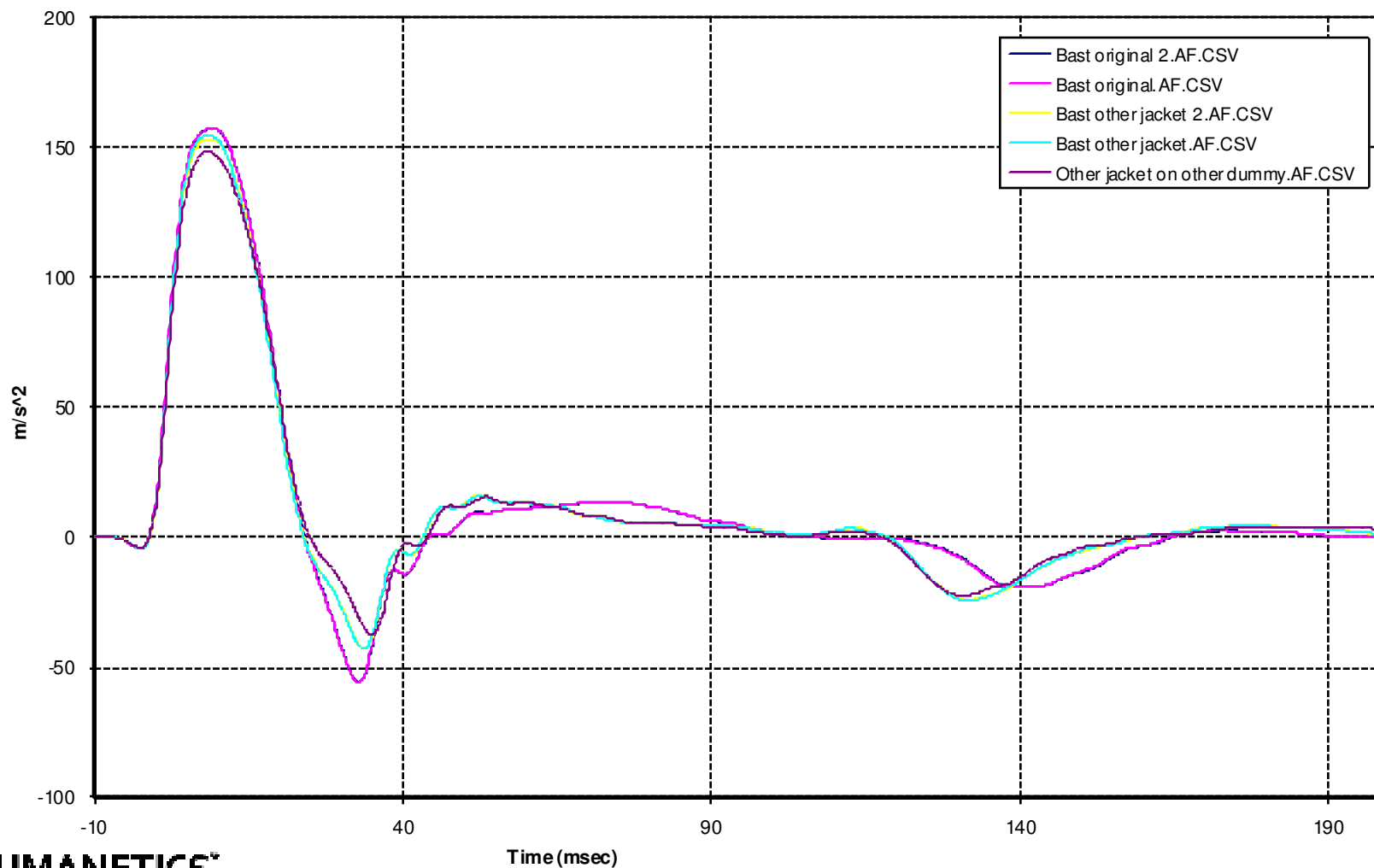
Cert. Test Jacket Comparison

T1 X Acceleration



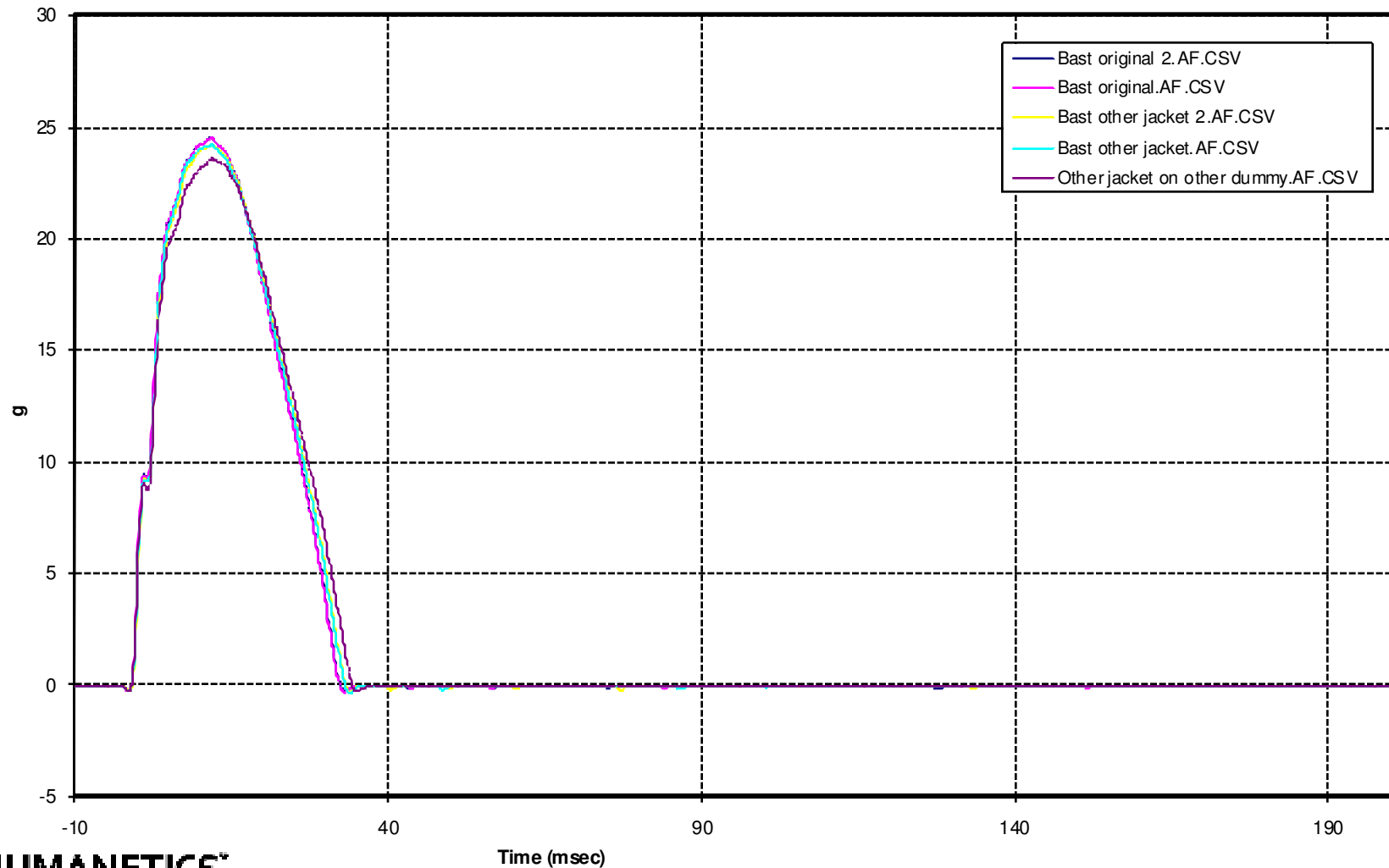
Cert. Test Jacket Comparison

Sled Acceleration



Cert. Test Jacket Comparison

Pendulum Decel



NORMAL VS LOOSE NECK PIN FIT STUDY

BioRID-II Vertebra Hole Fit Test Series

Normal vs Loose

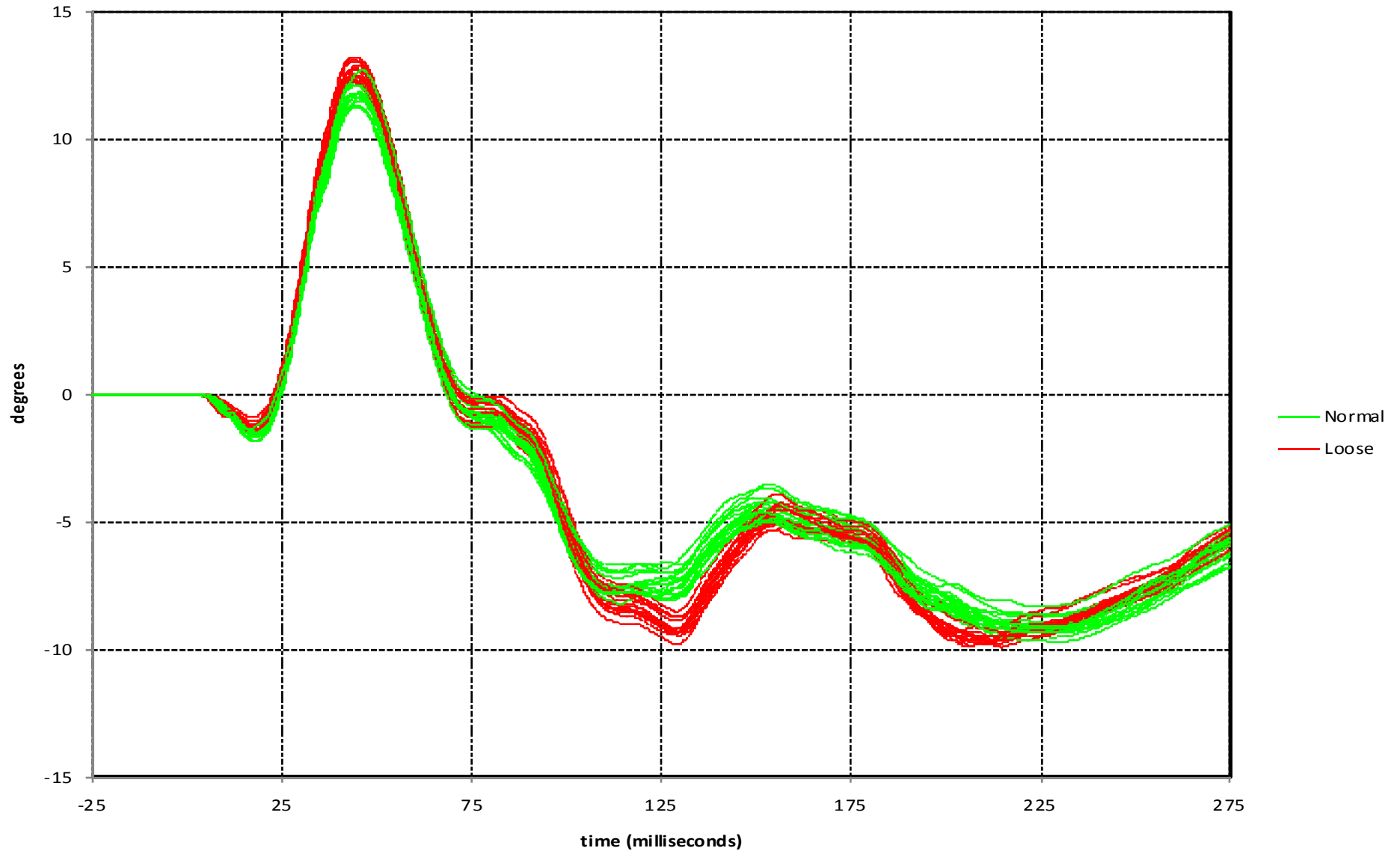
- ▶ Determine whether loose pin/hole fit causes differences in the Dummy Certification without Head Restraint.
- ▶ The loose pins of 0.0017" (0.043 mm) smaller than normal pins will simulate the fit differences of worn vertebra holes.
- ▶ Ran 5 tests each with 3 replicates for total of 30 tests.

BioRID-II Vertebra Hole Fit Test Series

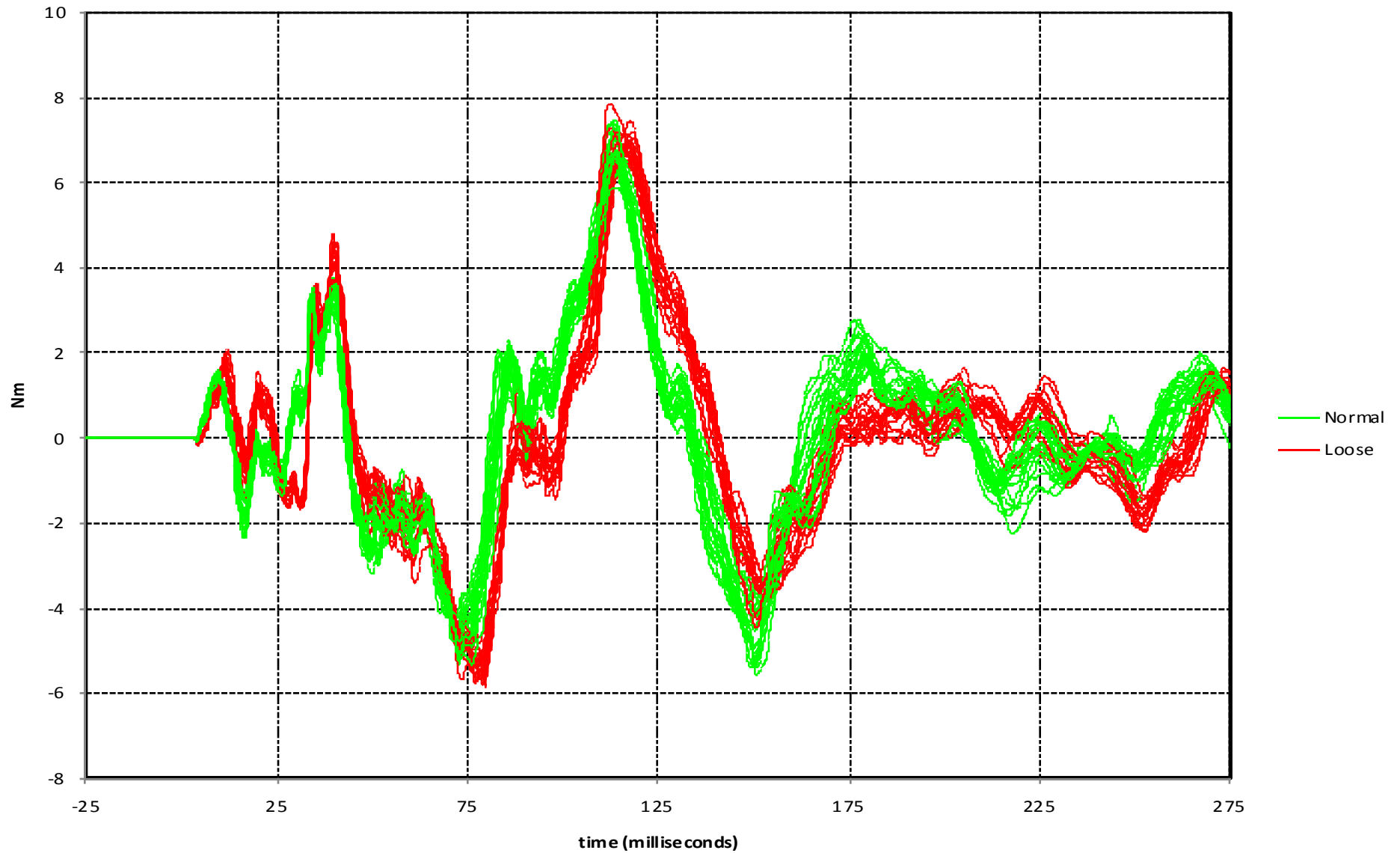
Normal vs Loose

- ▶ Test results show a small difference
 - Pot A
 - ▶ Loose vertebrae fit produces higher Peak 1 Rotations than the Normal fit.
 - Lateral loads
- ▶ A prior study of Normal vs tight showed a larger difference when there is pin to hole interference

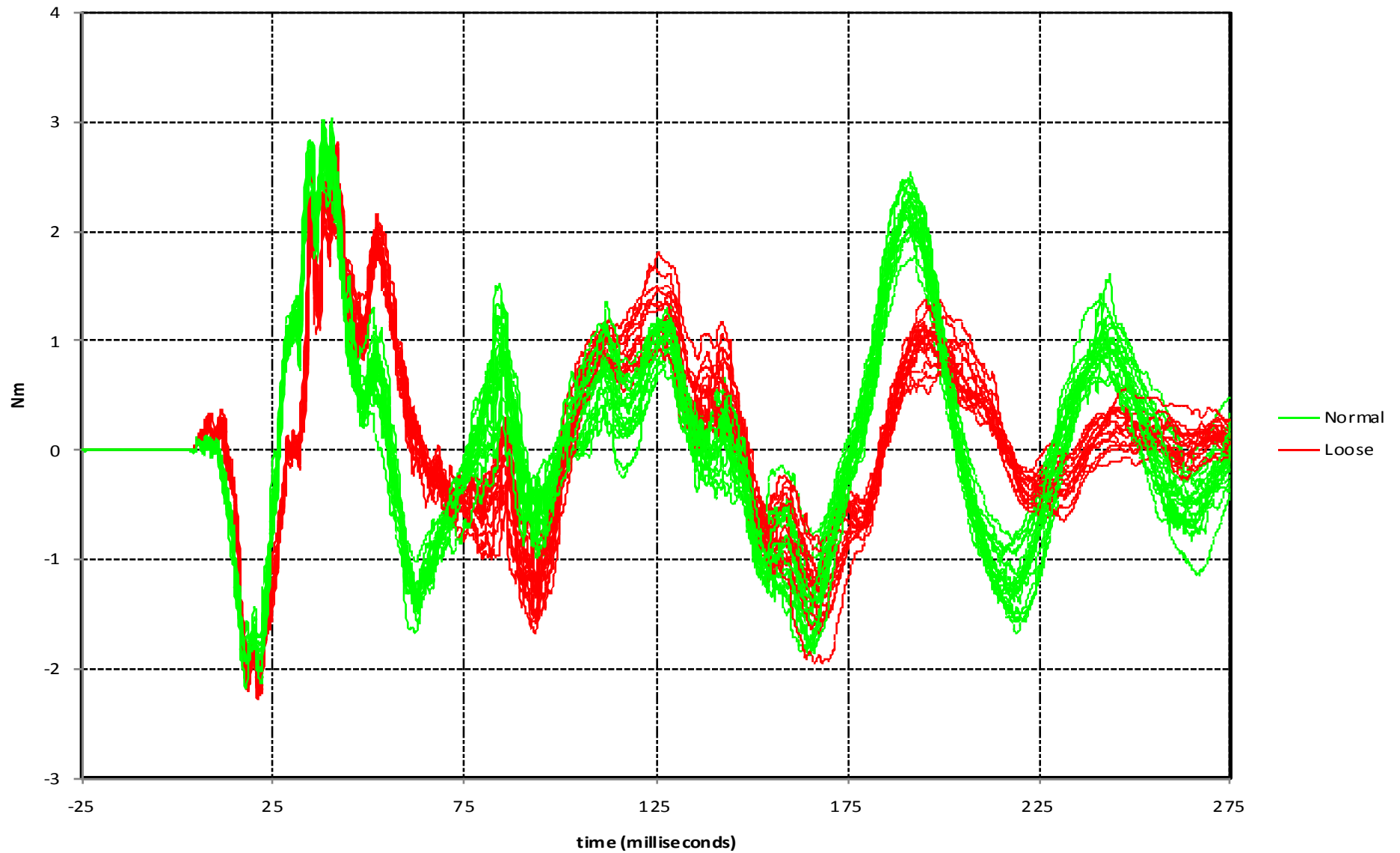
Pot A - Head Rotation about OC



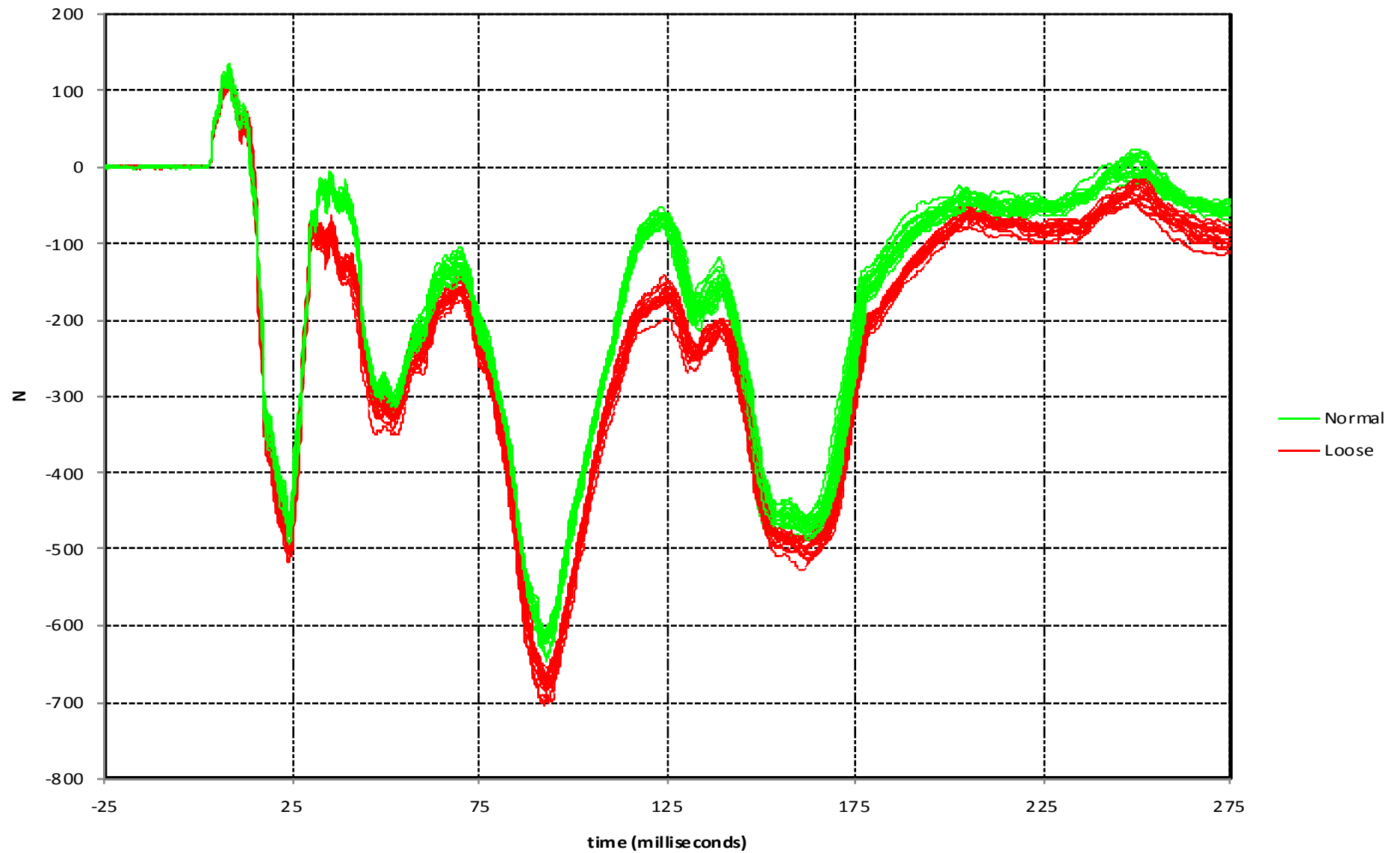
Upper Neck Moment MX



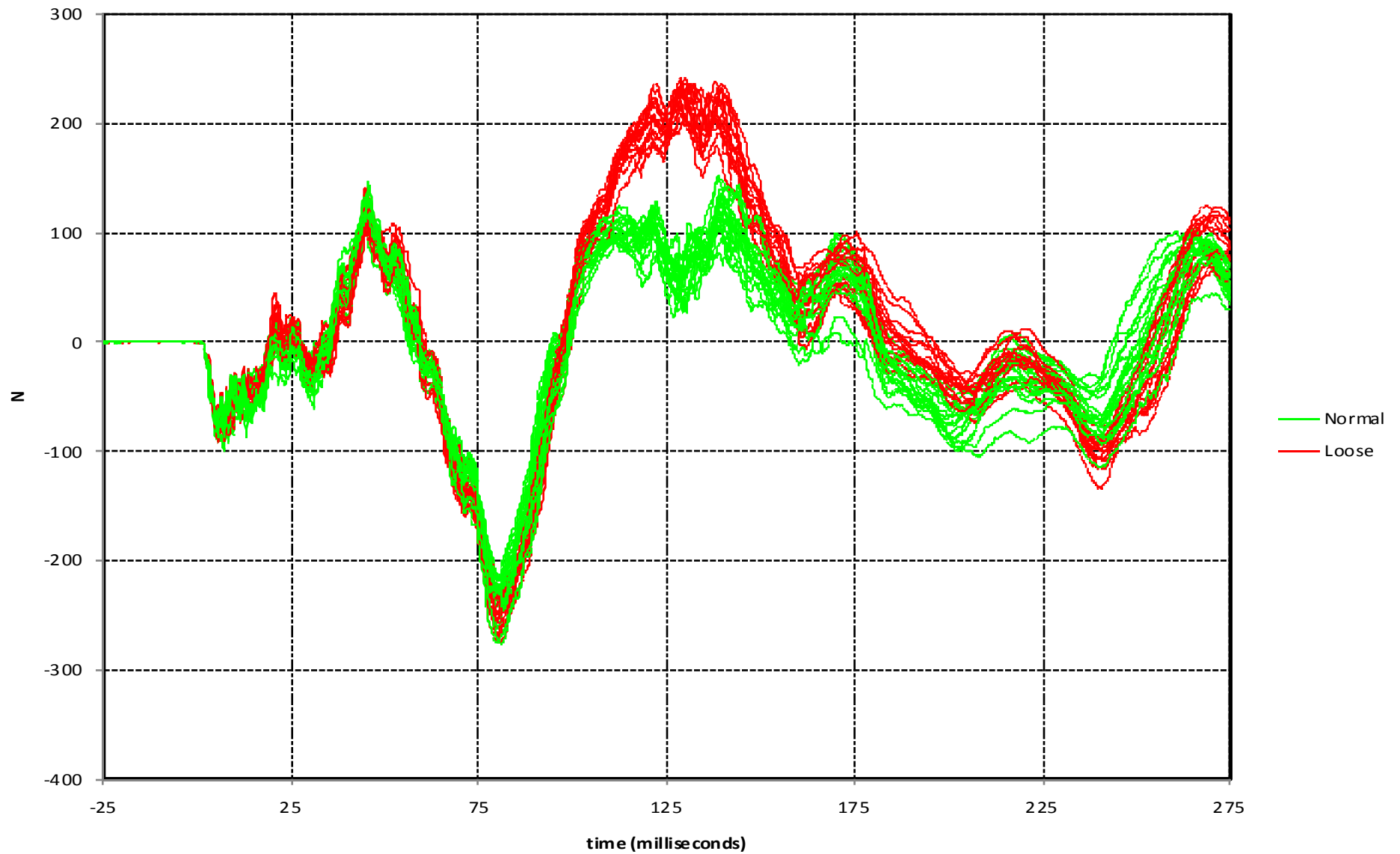
Upper Neck Moment MZ



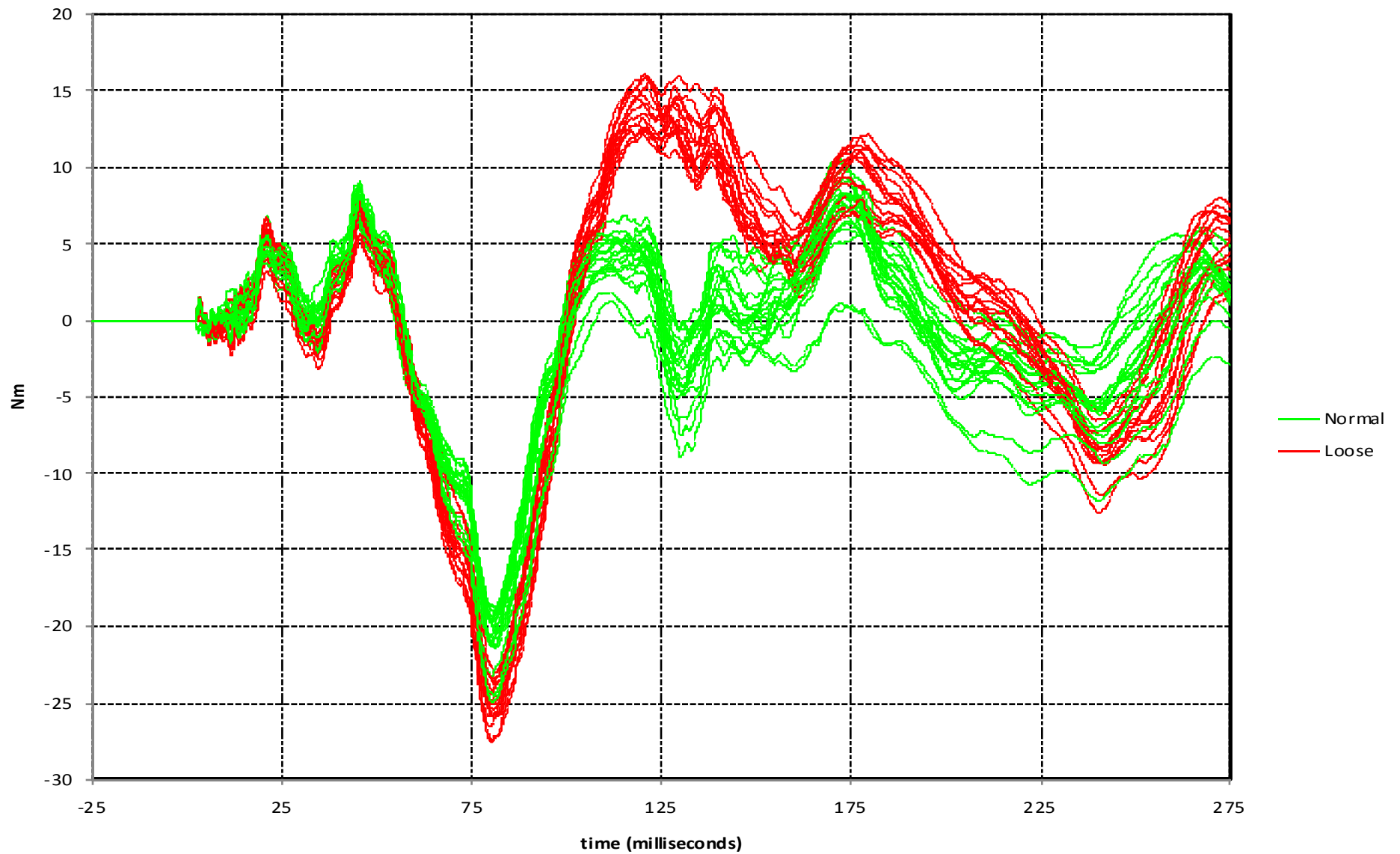
Lower Neck Force FZ



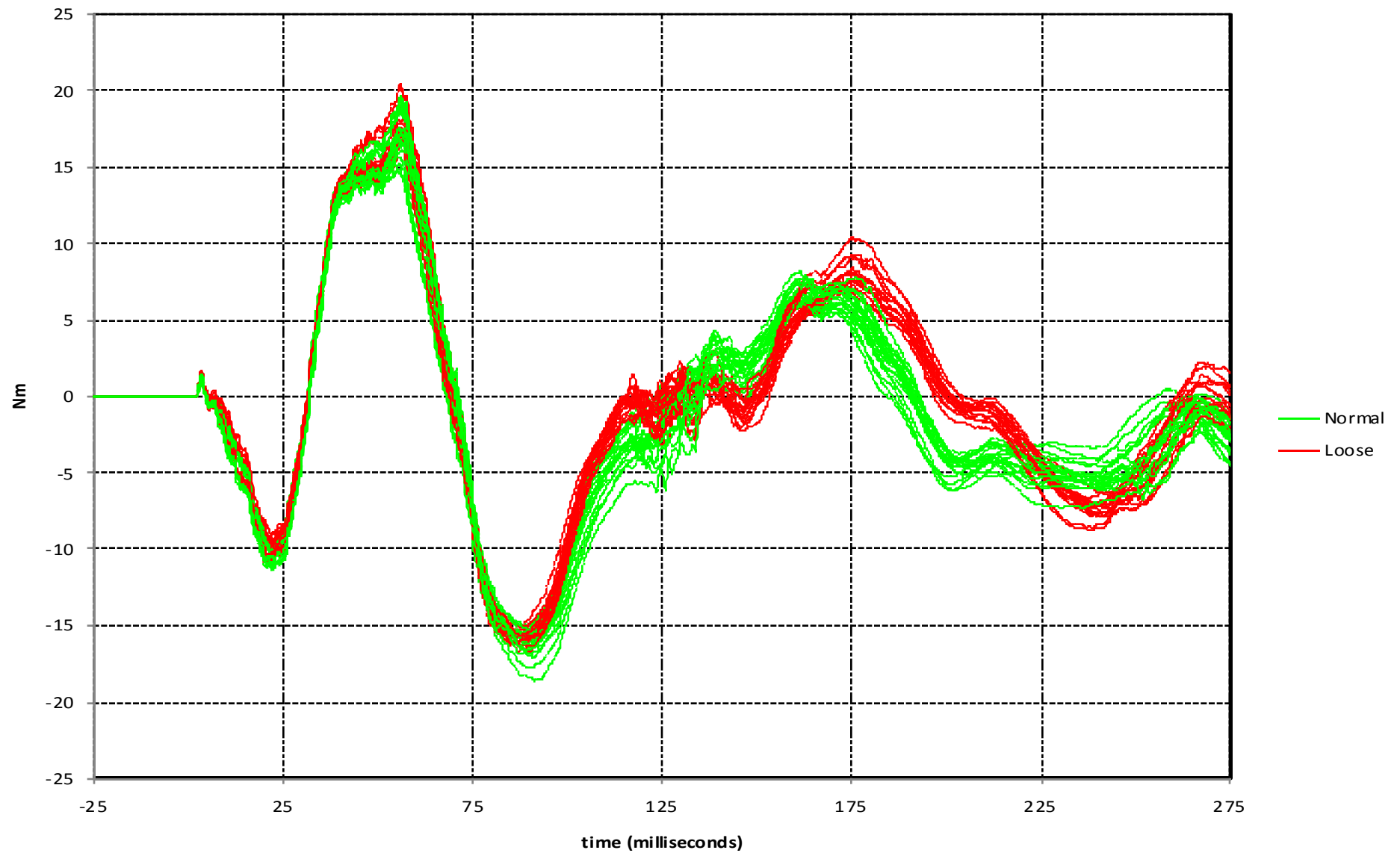
Lumbar Load Cell FY



Lumbar Load Cell MX



Lumbar Load Cell MZ



BioRID-II Hole Fit Tests

- ▶ What do we do about hole/pin fits
- ▶ To deal with worn holes
 - Use No-Go gage pin to check for worn holes
 - ▶ No-Go gage pin should be an interference fit. If you can push the gage in with one finger, then the vertebrae holes are worn and should be replaced.
- ▶ To prevent pin to hole tight fits (oversize pins)
 - Add a check to the manual to try installing pins between two vertebrae without cable tension
 - ▶ Pin should slide in pushing with one finger without tools. If not, pin is too large for holes
- ▶ Add Vertebrae hole check instructions to maintenance checklist located in the User Manual

UPDATE TO EFFECTS SUMMARY CHART

BioRID-II Effects on Certification Test Summary

Affect	Certification Tests	Head Restraint Certification Test	Sled Testing	Action Taken	Comments
Jacket Stiffness	Yes	Yes	Yes	Tighten Manufacturing Specs Dynamic stiffness test in development	Draft Stiffness Spec Due Sept 17
Water amount in Jacket	No	No, Minor affect to rebound	?	Add Weight spec for water install in jacket	
Head MMI	No	Minor Affect	?	TBD	
Damper Oil amount	No	No	No	None	
Pelvis Stiffness	No	No	Concern about seating height	TBD for MFG	Group did not want test for Cert
Lateral tilt adjustment of OC Plate	Yes	Yes	TBD	Revised Adjustment procedure under development Add Upper My to Cert Test	
Spine Set up	TBD	TBD	TBD		
Bumper Stiffness	TBD	TBD	TBD		
Vertebra Fit	TBD	TBD	TBD		
Muscle Spring Stiffness	TBD	TBD	TBD		

BioRID-II Effects on Certification Test Summary

Affect	Certification Tests	Head Restraint Certification Test	Sled Testing	Action Taken	Comments
Cervical Pin Fit (Normal vs Tight)	Significant Differences	Small Differences	TBD	Add inspection to user's manual	
Cervical Pin Fit (Normal vs Rusty)	No	No	TBD	Make sure all dummies have stainless pins	
Cervical Pin Fit (Normal vs Loose)	Small	TBD	TBD	Add inspection to user's manual	

QUESTIONS?