

KOREA GTR No.7 2nd Phase Research Results

Dec. 8, 2009

**Ministry of Land, Transport and Maritime Affairs,
Korea Automobile Testing and Research Institute**

Backgrounds - regulatory

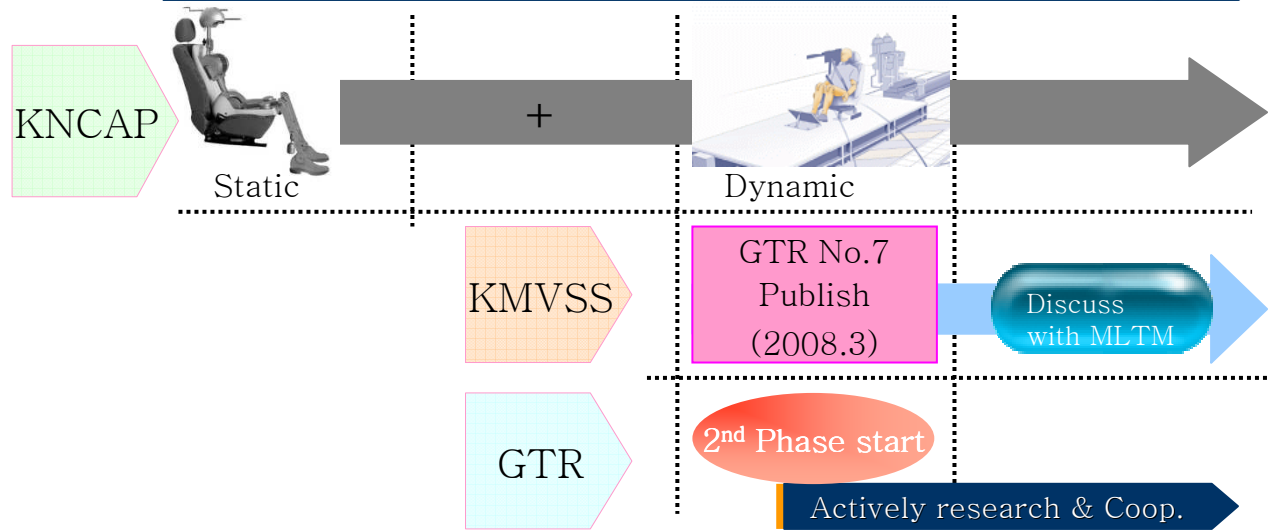
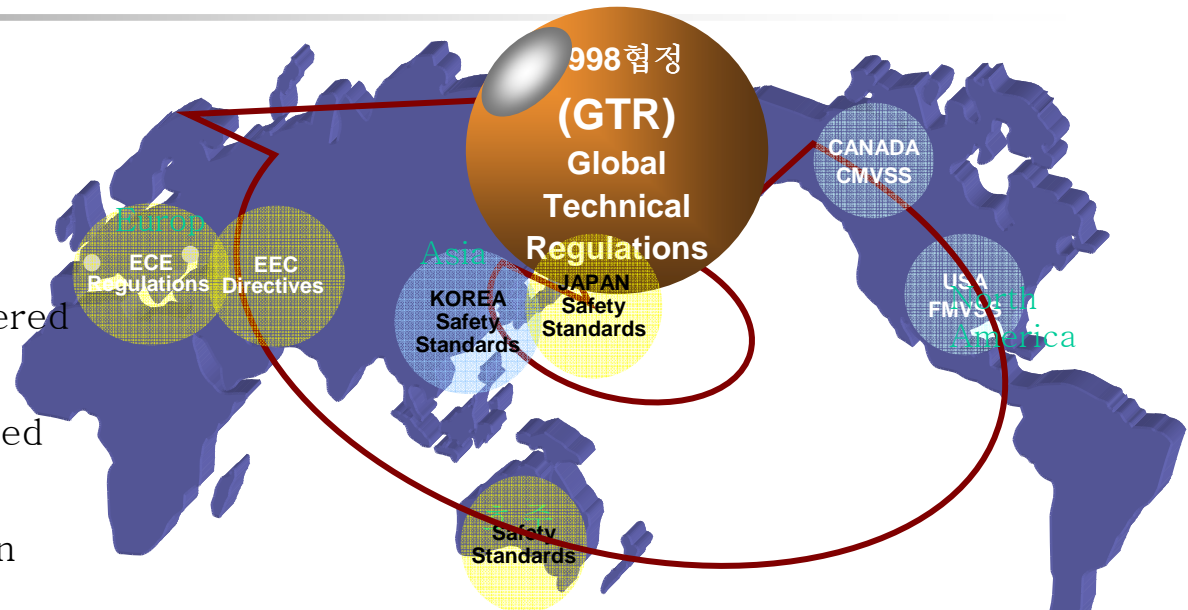
KOREA

● Headrest. KMVSS upgrade plan

- ✓ During GTR 7 discussion, KOREA considered harmonization with lead time, etc.
- ✓ All possible GTR options will be considered on KMVSS.
- ✓ Phase I GTR will be adopted as KMVSS in 2010.
Before GTR introduce in KMVSS, make the program (gov)

Adopting in KNCAP & Lead Good H/R Performance

Offer the advantage of design preceding, etc.



Objective of KOREA Research

➤ Objective

- ✓ Harmonization of GTR No. 7 in KMVSS
- ✓ Global cooperation for Head restraints
GTR Phase II

➤ Work Scop

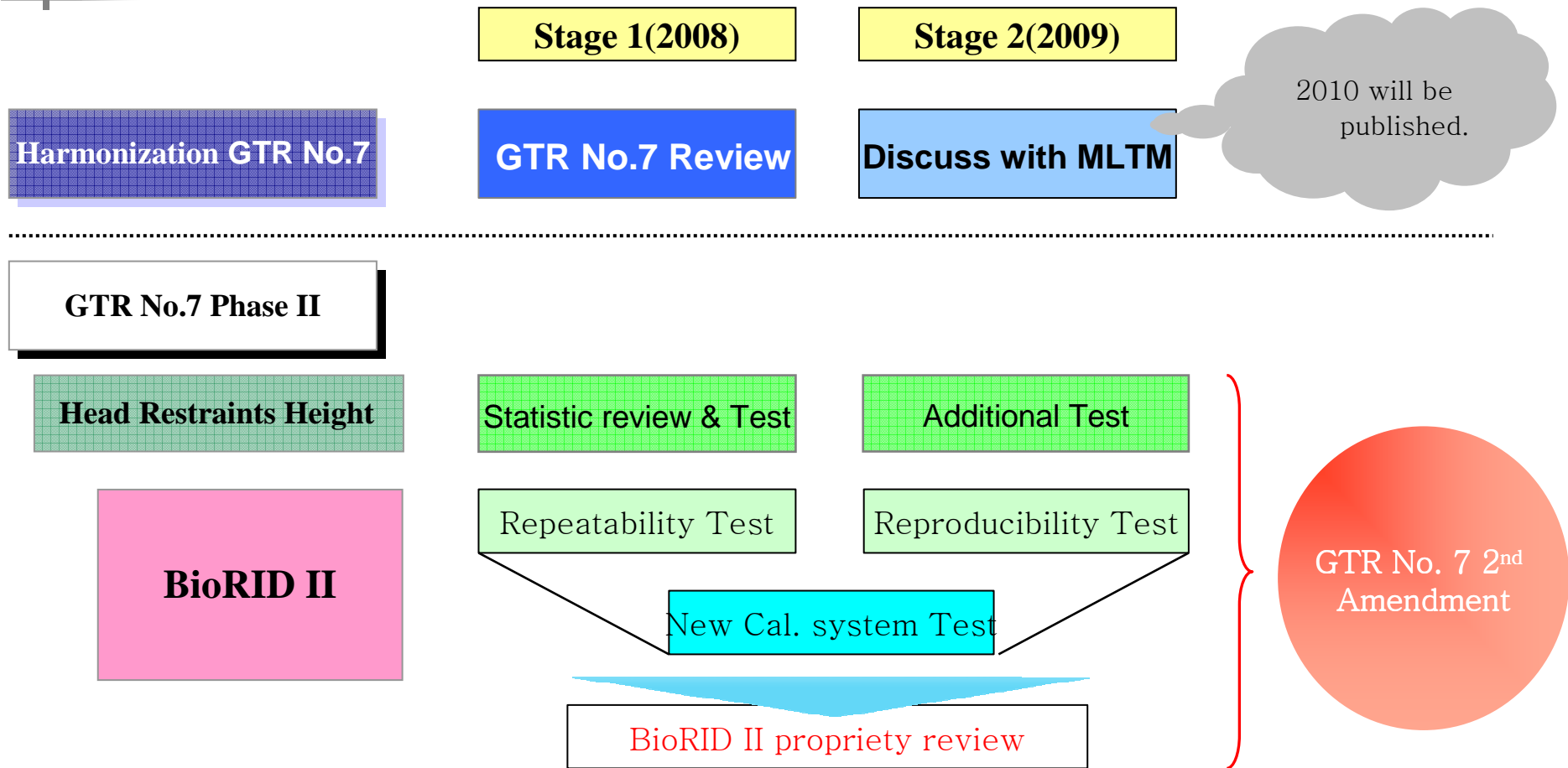
- ✓ GTR No.7 Phase II
 - Head restraints height : Effective height
in KOREA
 - Dynamic Test
 - Evaluation of BioRIDII : Repeatability,
Reproducibility
 - Evaluation injury indicator in BioRIDII
 - Check the BioRIDII calibration procedures

GTR

➤ GTR 2nd Phase Terms of reference

- ✓ Head restraint Height
- ✓ Whiplash Injury (MAIS1 or MAIS 2 more)
- ✓ Define Test procedures
 - Test condition
 - Clarify the mechanism of whiplash injury
 - Evaluation of BioRIDII
 - Evaluation of Indicator
 - Feasibility studies etc.

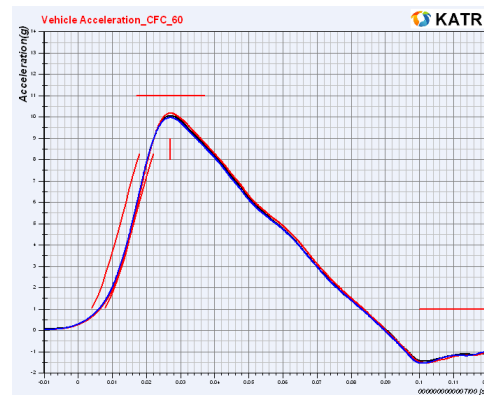
Over all Research Schedule



Evaluation of BioRIDII performance

◆ Test Condition

- Dummy & Number of tests
 - Denton 3 different BioRIDII-g (S1, S3, S4)[Dummy was calibrated before the test.]
 - 3 times Test in KATRI(engineer also KATRI persons)
- Pulse : KNCAP (Same as the E-NCAP Medium pulse 16km/h)
- Seat & Head restraints setting : KNAP(Same as the the E-NCAP)
- Neck injury indicator :
 - Head X acc, Nkm, NIC, HRC, T1 X acc, Upper-Fx -Fz -My, Lower-Fx, -Fz,- My



[Seld Pulse]

Location	Target measure	Tolerance
H-point (X-axis)	+20mm Forward	±10mm
H-point (Z-axis)	0mm	±10mm
Pelvis angle	26.5°	±2.5°
Head plane angle	0°	±1°
Backset	15mm Forward	±5mm

[BioRID Setup Summary]

Evaluation of BioRIDII

◆ Method of Evaluation

➤ Repeatability

$$C.V = \frac{S_d}{\bar{X}} 100 (\%)$$

\bar{X} = Mean value of each dummy

S_d = Standard deviation of each dummy

➤ Reproducibility

$$C.V = \frac{S_B}{\bar{X}_G} 100 (\%)$$

$$S_B = \left[\frac{MSB-MSW}{n} \right]^{1/2}$$

\bar{X}_G = Mean value of 3 dummies

MSB : Mean square between groups (dummies)

MSW : Mean square in a group (each dummy)

n : Number of repetitions of test

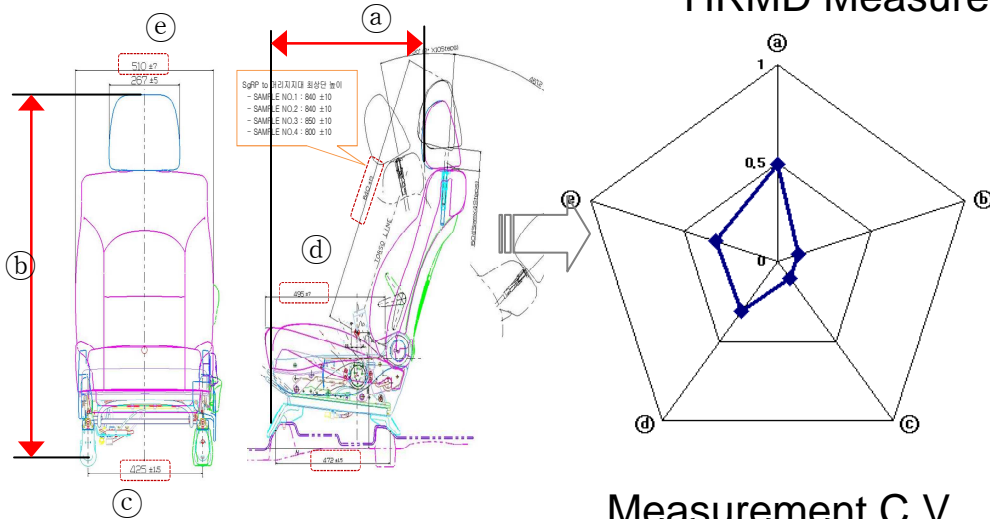
CV = 3%	3% < CV = 7%	7% < CV = 10%	CV > 10
good	acceptable	marginal	not acceptable

Evaluation of BioRIDII

◆ Seat condition & Dummy setting



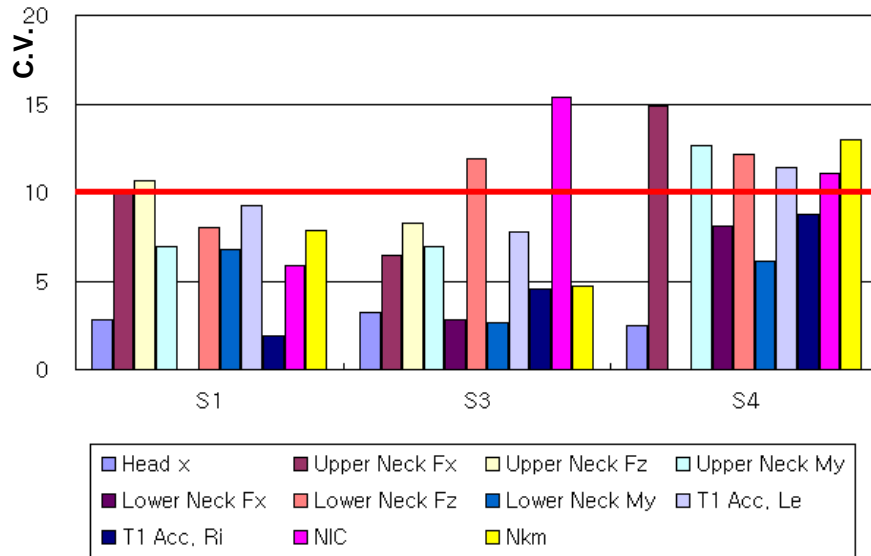
HRMD Measurement



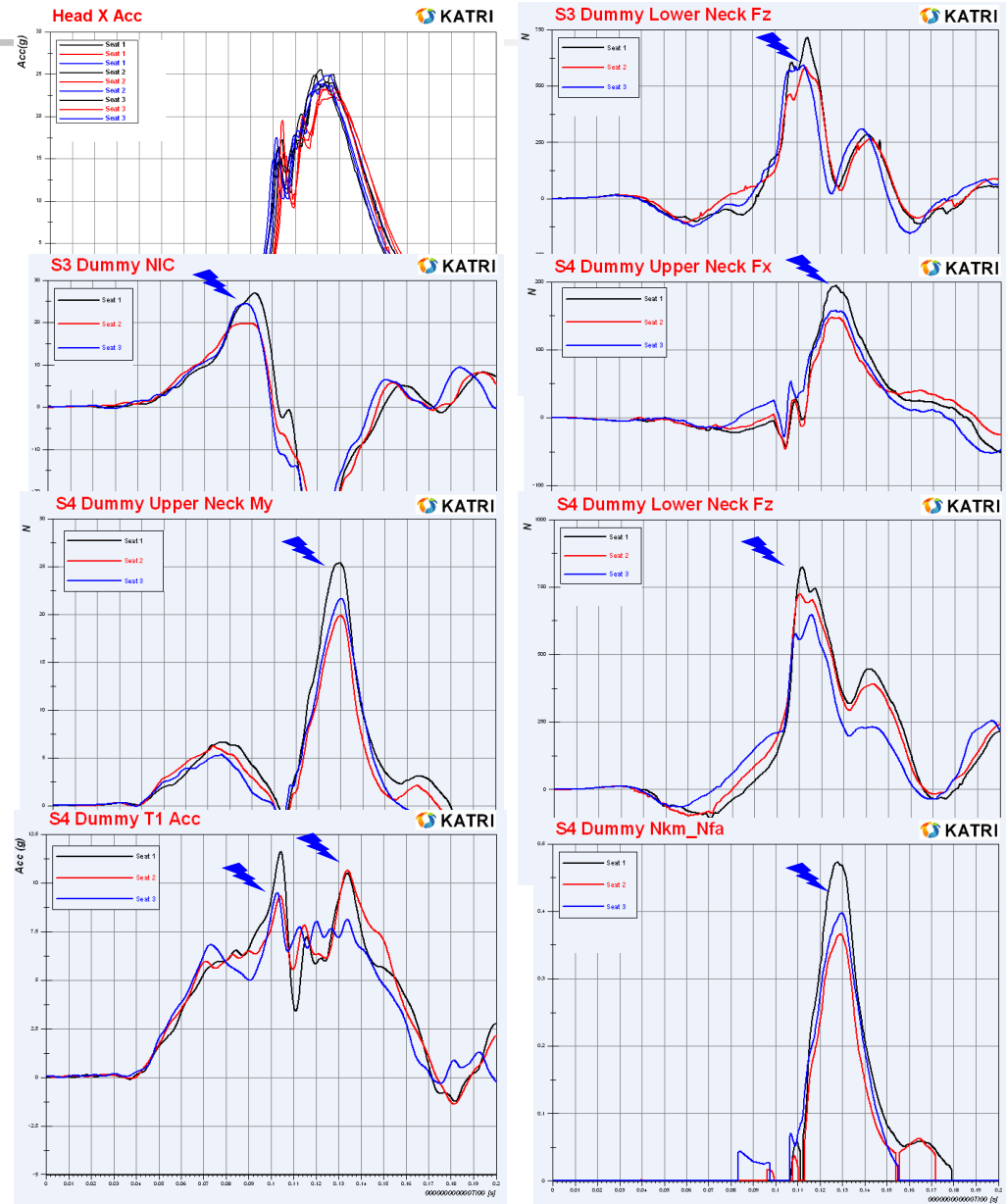
Measurement C.V

Evaluation of BioRIDII

◆ Results of Repeatability Evaluation

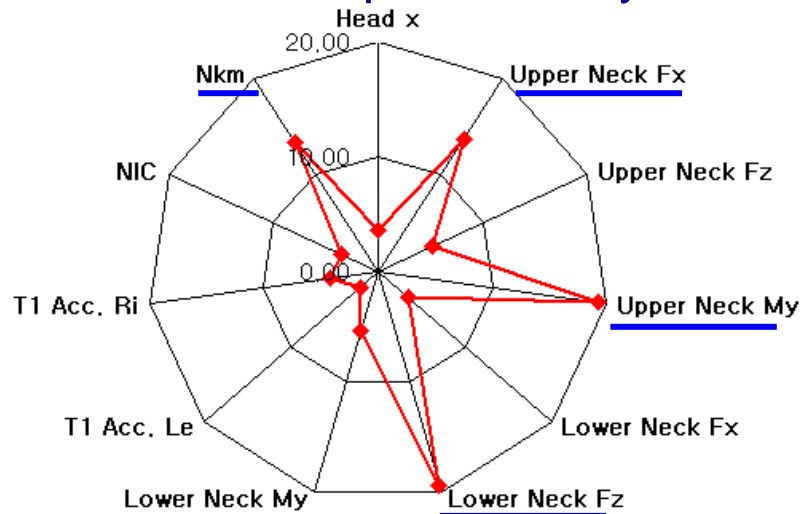


- ❖ Head X repeatability in all dummy is good.
- ❖ Among 3 dummies, each C.V. does not show consistency but graphs are pretty similar.
- Even though BioRID calibrated, repeatable variation has been depend on dummy.

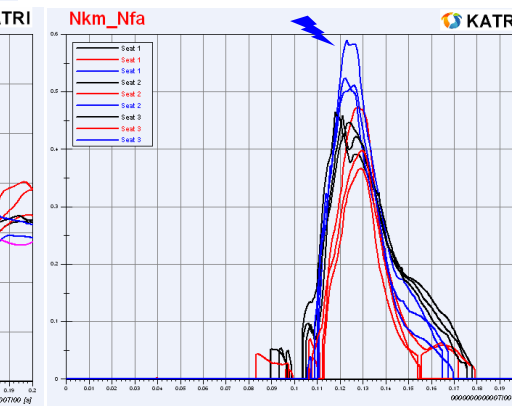
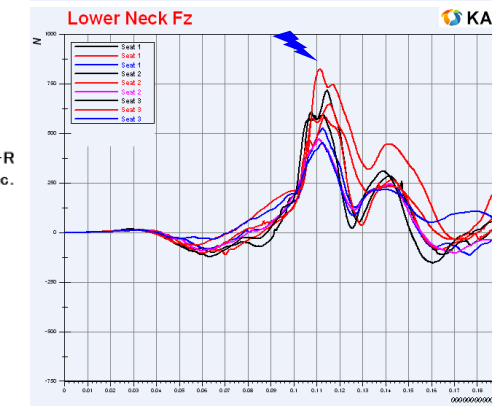
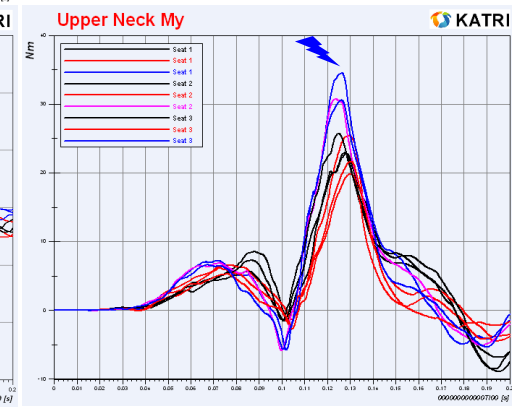
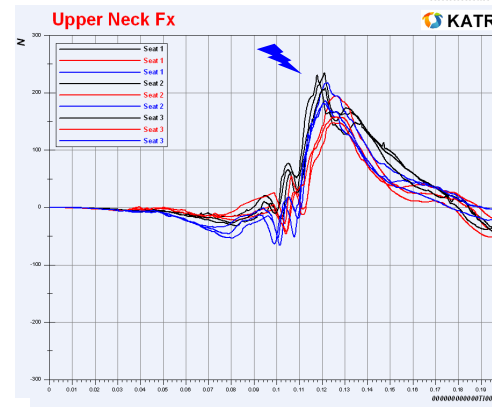
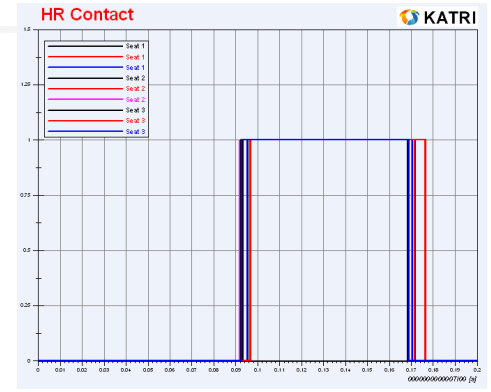
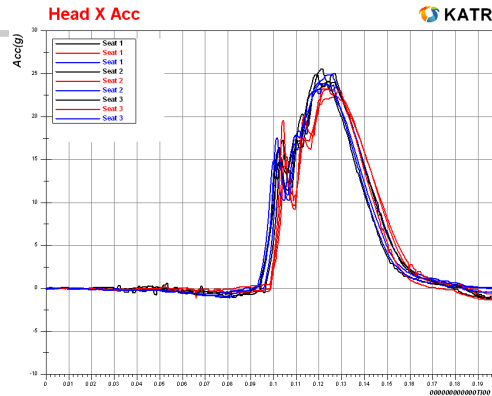
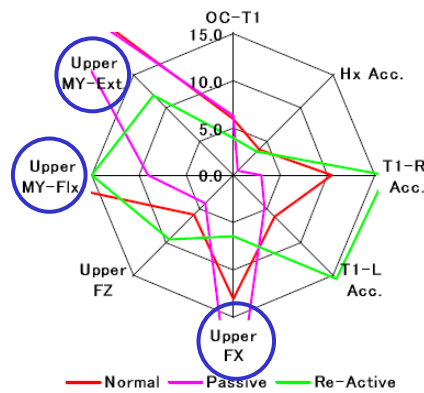
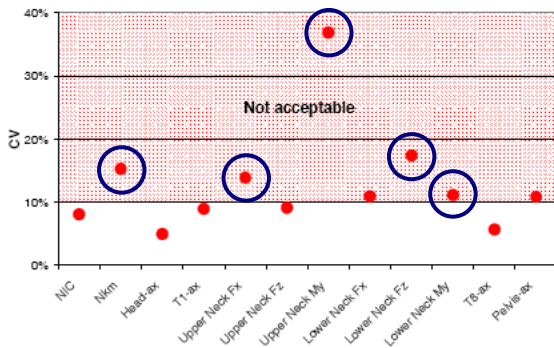


Evaluation of BioRIDII

Results of Reproducibility Evaluation



Upper Fx & My, Lower Fz, Nkm_Nfa are not acceptable indicators during the test.



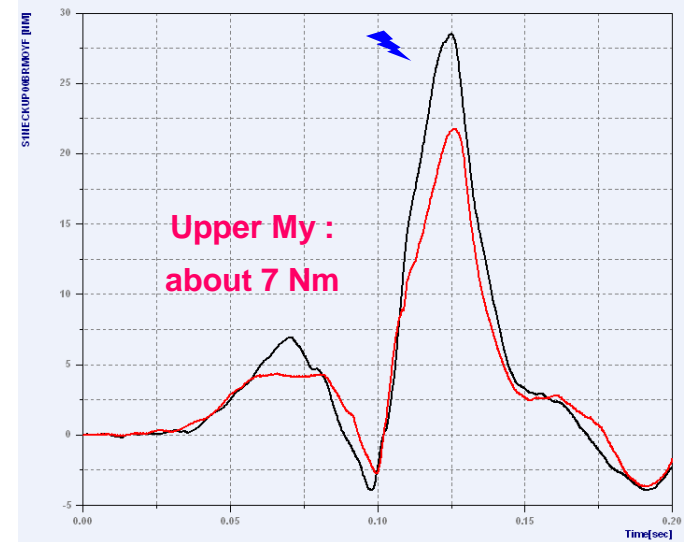
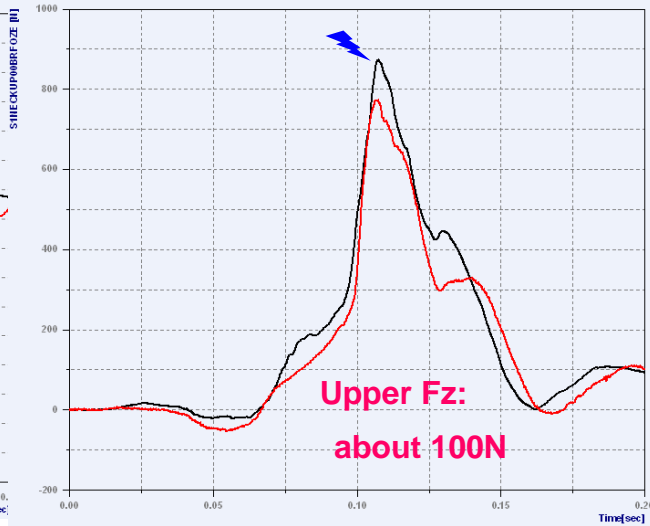
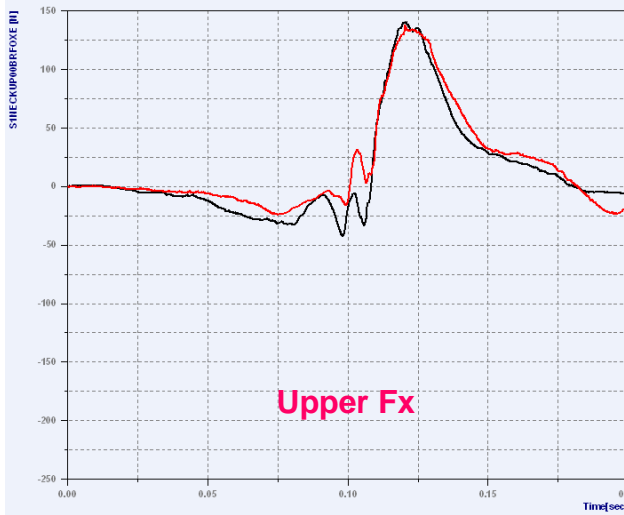
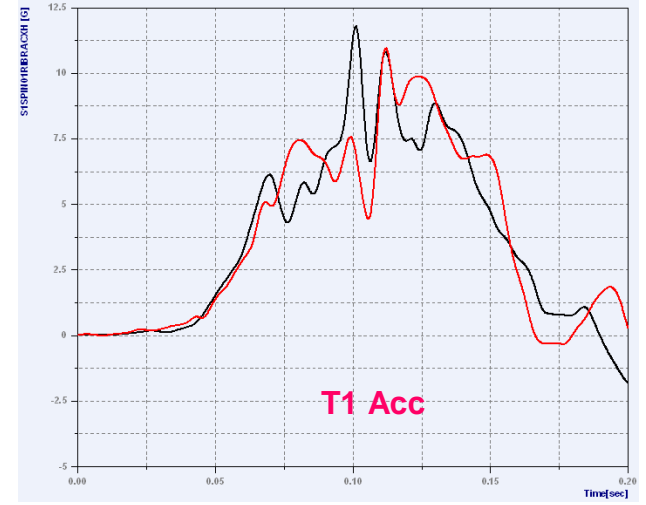
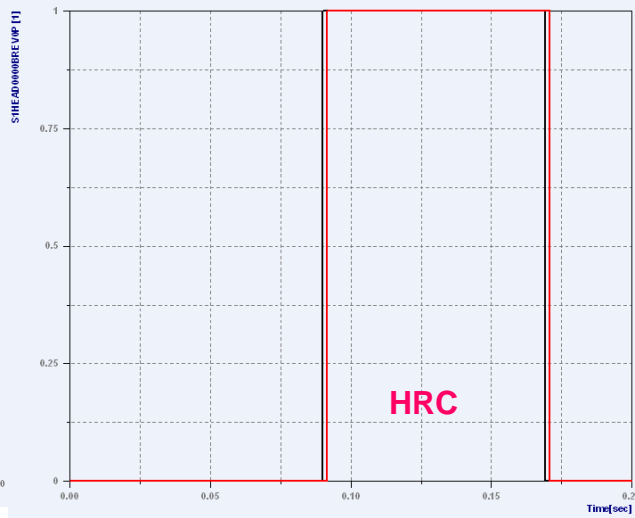
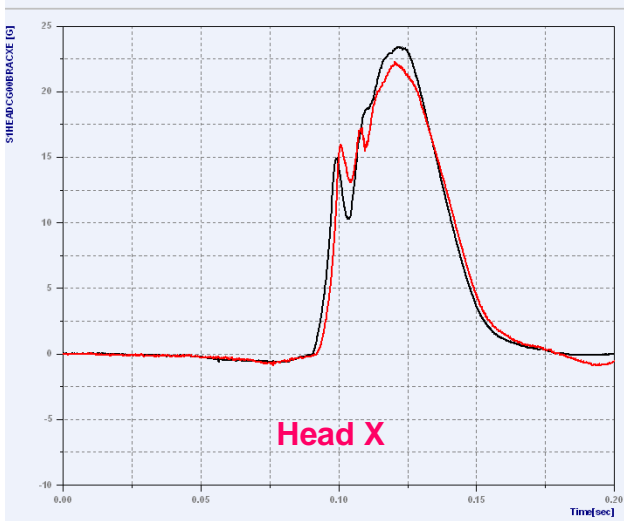
Evaluation of BioRIDII – Test site variation

◆ Test Condition

- Dummy : BioRIDII-g 1 test each site.
- Test Site : 2 different site (Hyundai, Dymos)
- Pulse : KNCAP (Same as the E-NCAP Medium pulse 16km/h)
- Seat : same seat, other conditions same repeatability test

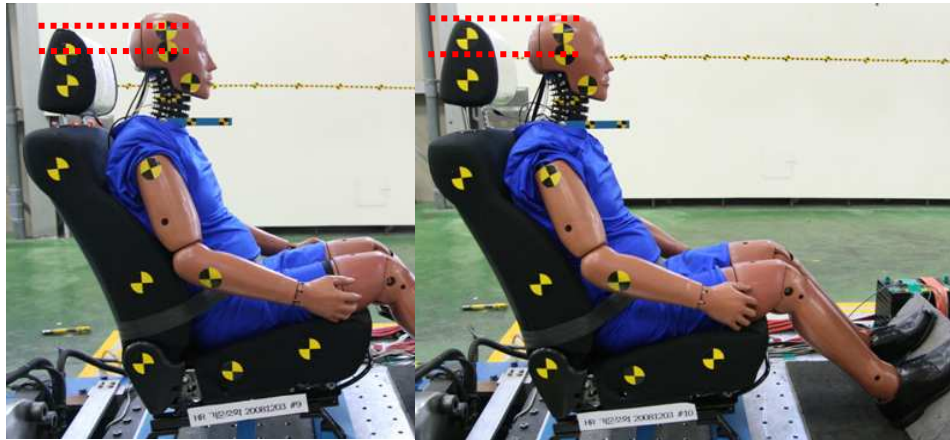


Evaluation of BioRIDII – Test site variation



Head Restraint Height – Non Active Seat

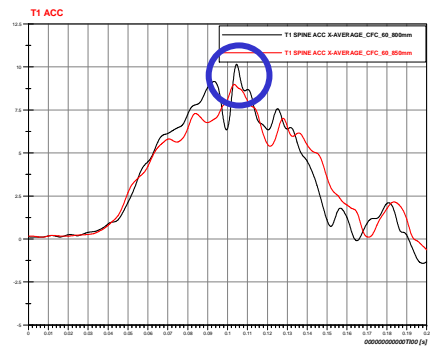
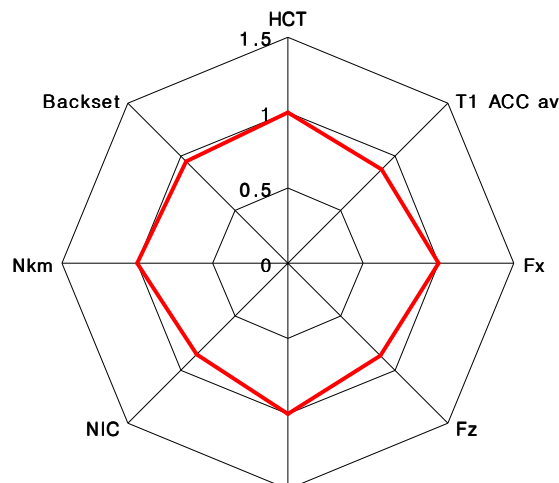
❖ Review of KOREA Anthropometry statistics,
the reasonable height of Head Restraint is 800mm



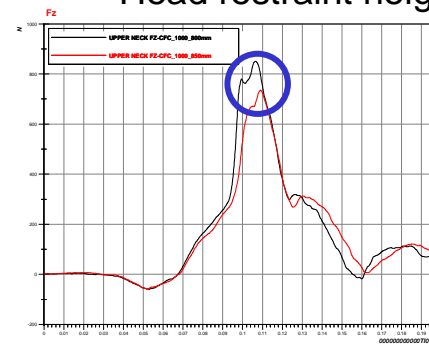
Headrest. height 800mm

Headrest. height 850mm

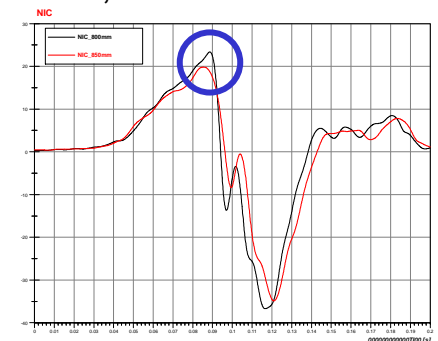
- Purpose
 - Neck Injury indicators analysis comparing 800 & 850mm H/R height
- Test condition
 - Pulse : K-NCAP (E-NCAP medium pulse)
 - Seat setting : K-NCAP
 - Dummy : Denon BioRID lig (KATRI)
 - Head restraint height : 800, 850mm



T1 Acc av



Upper Fz



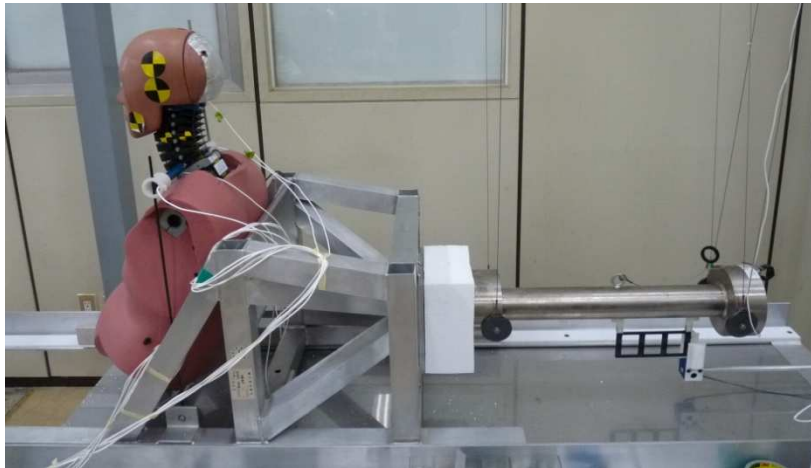
NIC

❖ Indicators on 800mm height H/R are slightly higher than 850mm height H/R

❖ But not a big different.

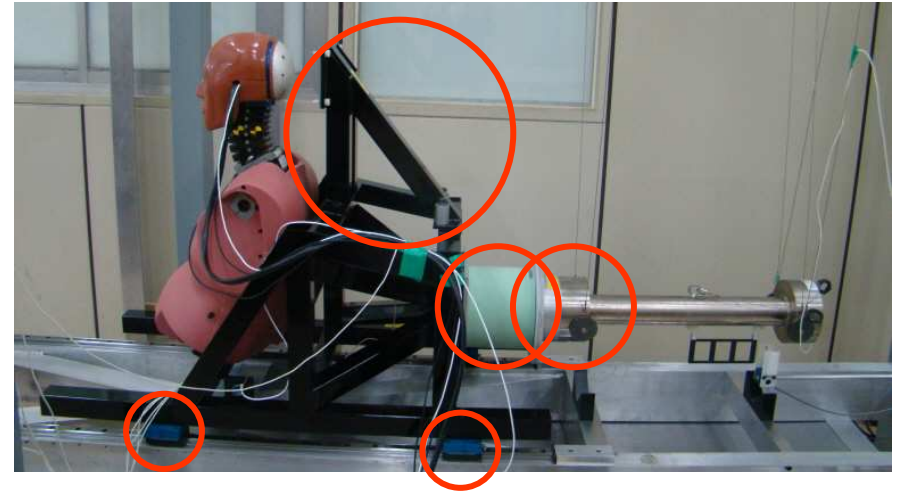
Evaluation of BioRIDII Calibration procedures

Current Version



New Version

○ : Changed part



- Changed Parts : Head Rest Jig, Foam block, Probe, Sliding guild.

◆ Evaluation

- Repeatability Test : Graphs review
- Dummy : 4 ea Denton BioRIDII-g
- Test condition : Each dummy passed the current cal procedures and then
3 or 4 tests of each dummy were conducted on the new cal. system with H/R & not.

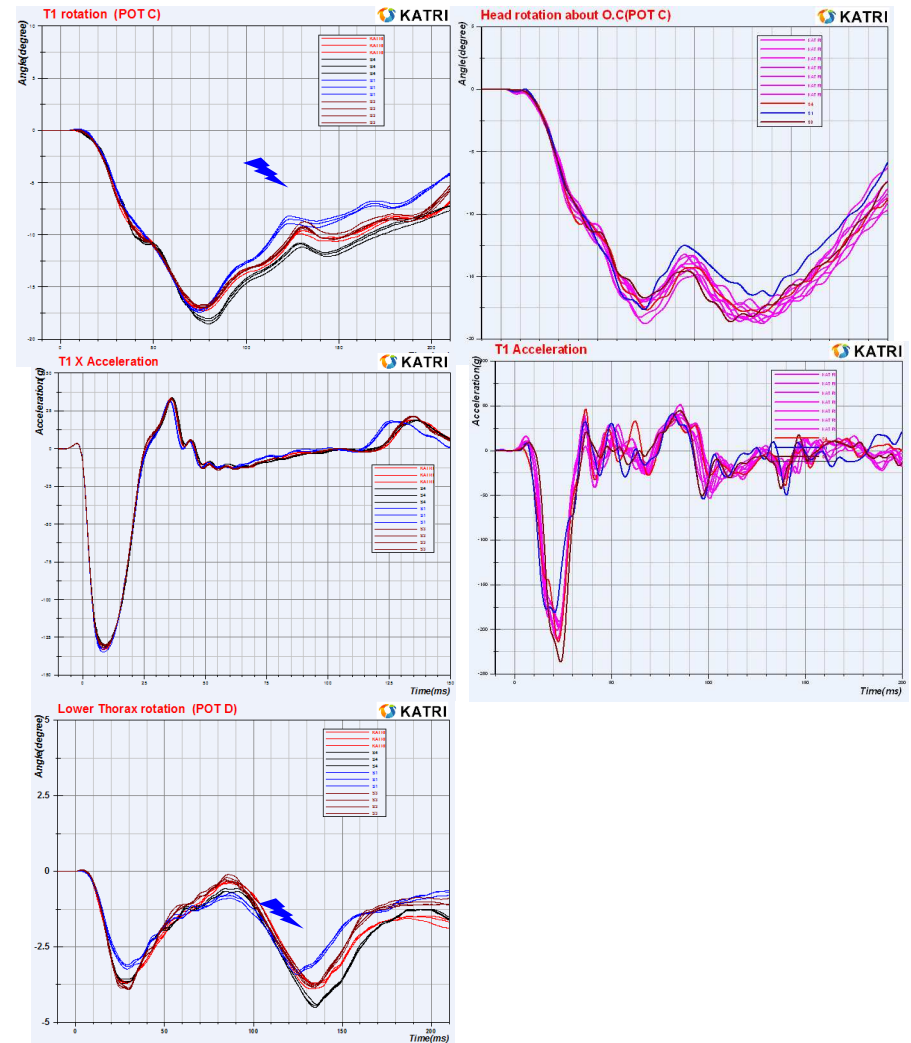
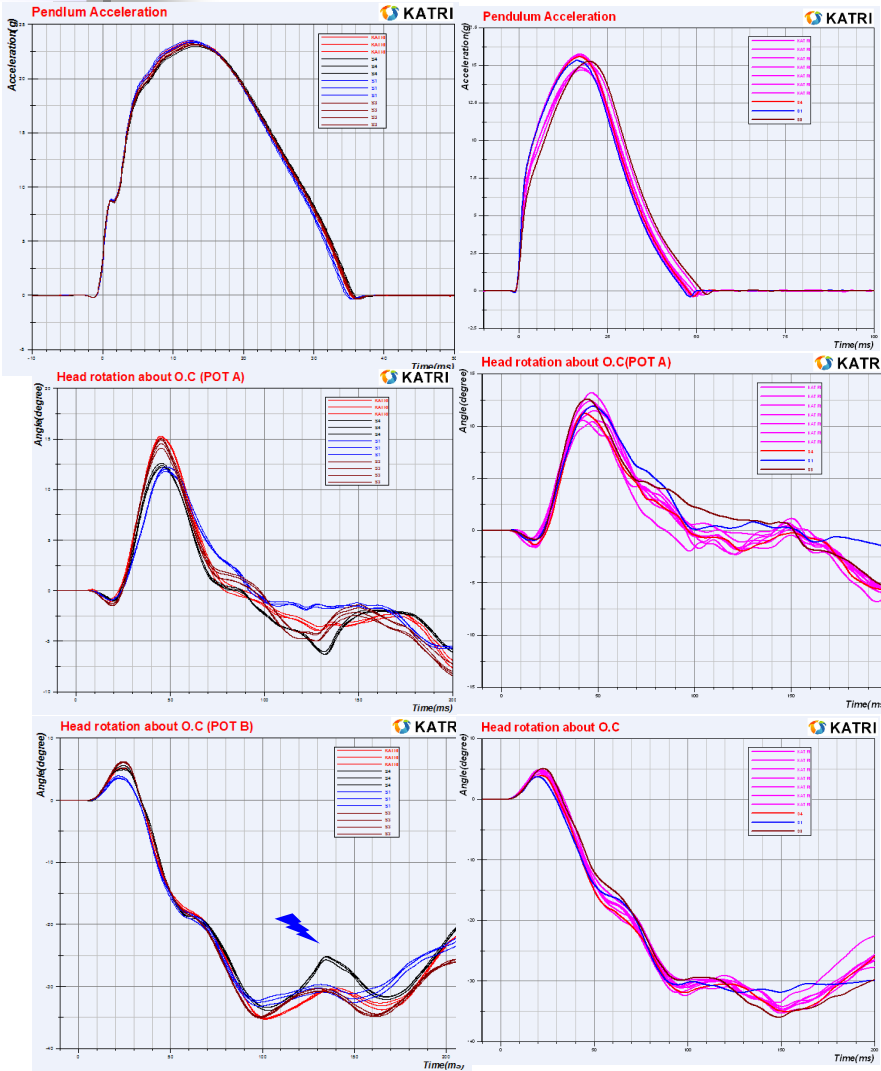
New sled without H/R Jig Cal. Result Graphs

New Sled

Old Sled

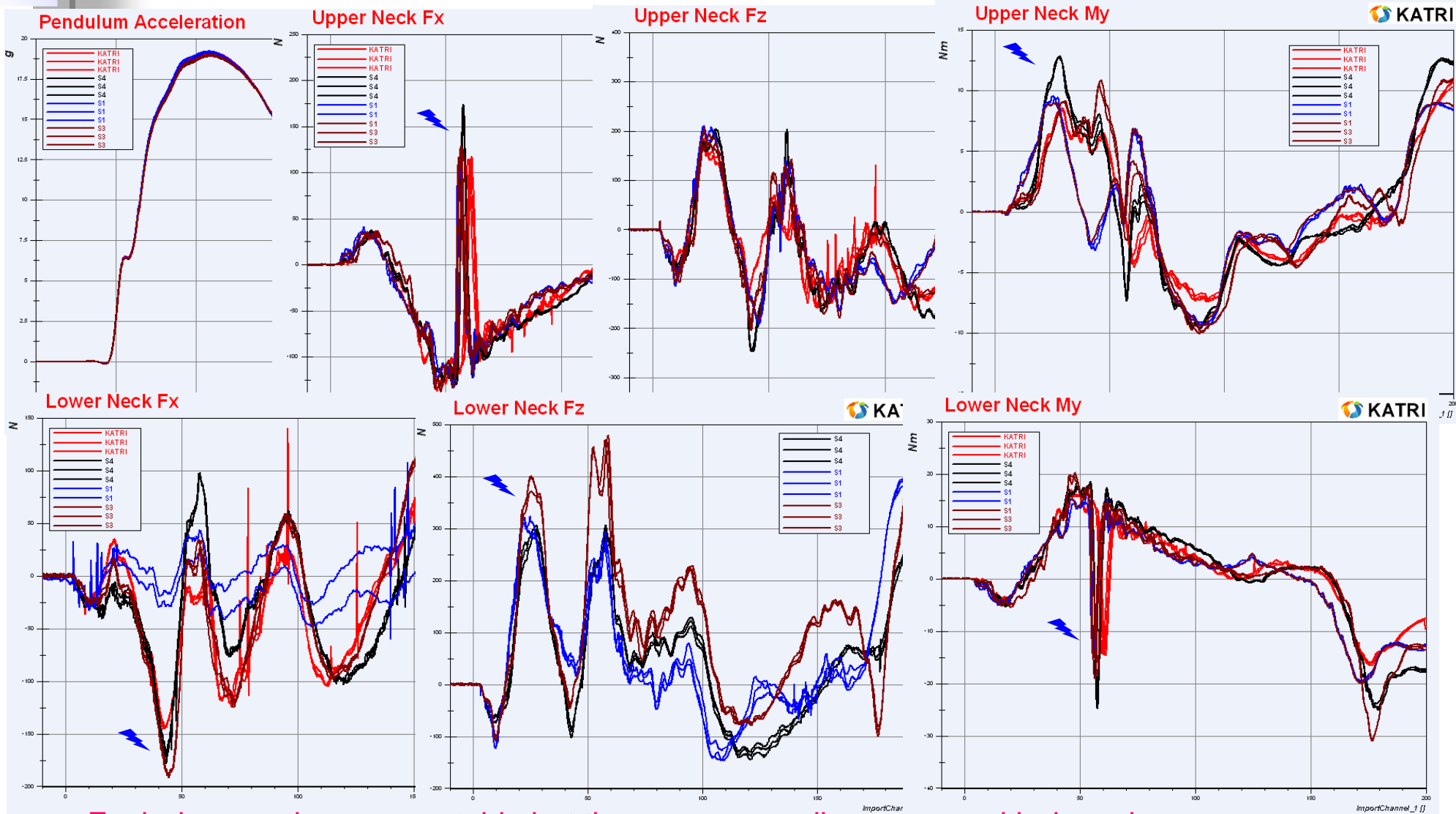
New Sled

Old Sled



Each dummy shows repeatable but there are some discrepancy with dummies.

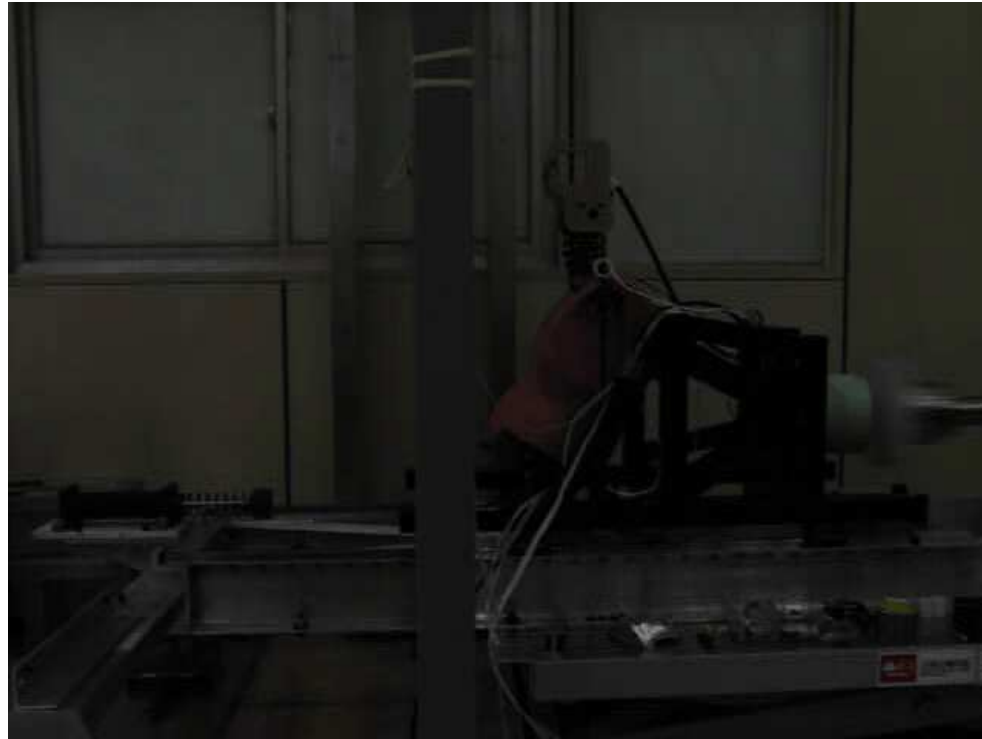
New sled wit H/R Jig Cal. Result Graphs



Each dummy shows repeatable but there are some discrepancy with dummies.

(Upper Neck Fx, My, Lower Neck Fx, Fz, My)

Other Issue



- Pendulum force on new sled system is much higher than old version, so head & neck movement is too strong and too much. It's cause of neck bumper separation during the calibration test.
- During the cal. test setup, sled keep moving, need fixing jig.

Evaluation of BioRIDII – Denton & FTSS

◆ Test Condition

- Dummy : BioRIDII-g Denton & BioRIDII FTSS.
- Test Site : KATRI, Test setup : same condition (repeatability test condition)
- Test number : 3 times

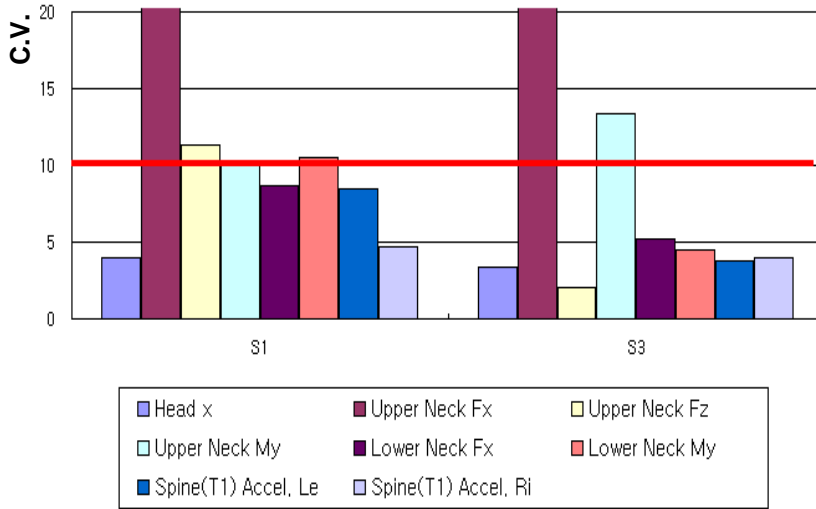


Before

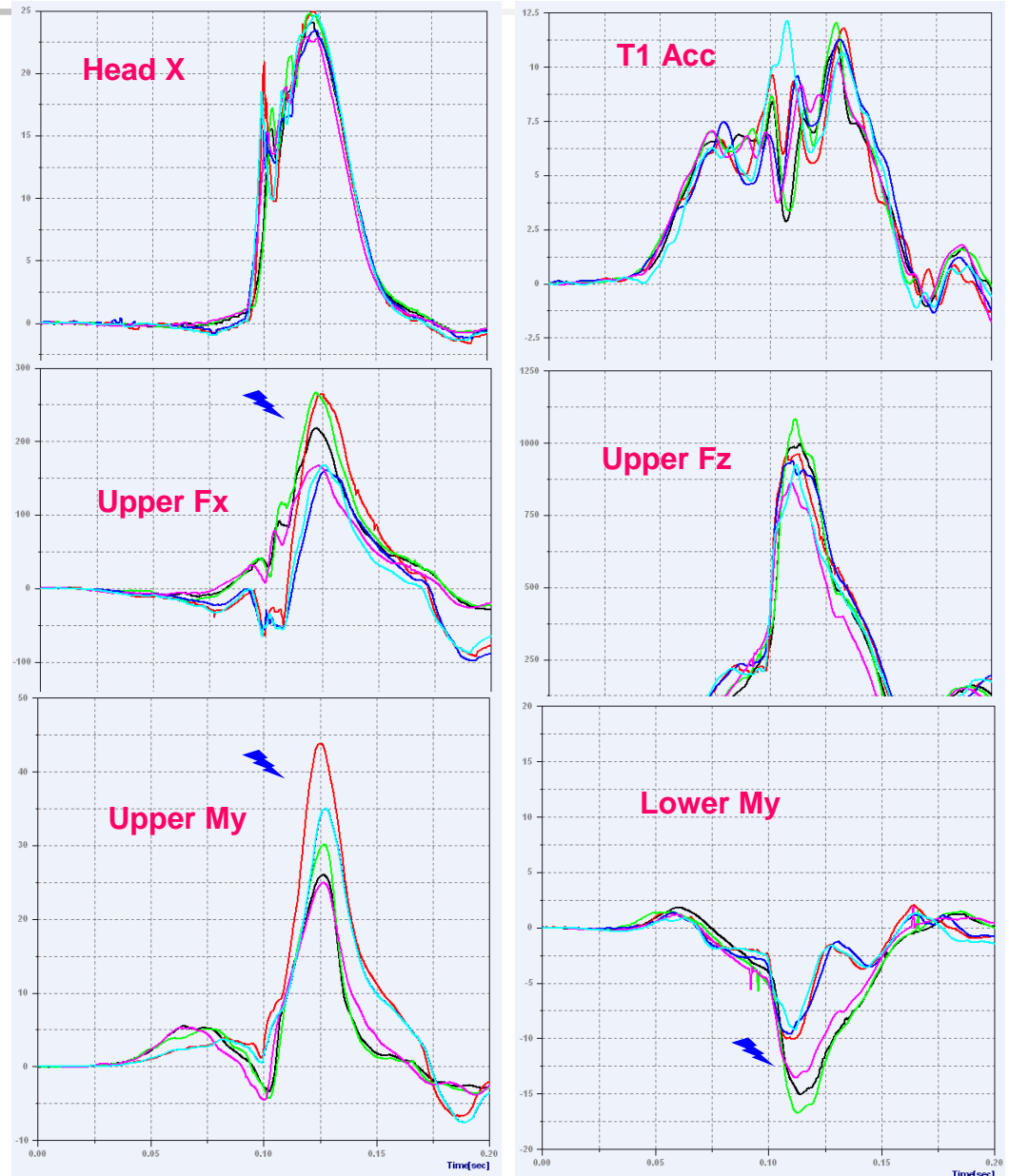


After

Evaluation of BioRIDII – Denton & FTSS



- ❖ Head X repeatability in two dummies are good.
- ❖ Upper Fx is not acceptable with two dummies
- ❖ Upper Fz & My & Lower My in Denton BioRID and Upper Fz in FTSS BioRID is not acceptable for repeatability analysis.



Summary

- ❖ Result data for neck injury indicators on BioRIDII
 - Repeatability : S1 & S3 dummy is marginable but S4 dummy is not acceptable.
 - Reproducibility : Not acceptable for Upper Fx, Upper My, Lower Fz, & Nkm.
Similar results submitted last ESV. (Japan & Europe)
 - Results of different site test are similar except upper Fz & My.
- ❖ With repeatability & reproducibility issues, we may suggest some robust indicator after full consideration for neck injury mechanism in stead of neck injury indicator.
 - In terms of the regulation, small variation of seat condition must be acceptable.
(Seat is not rigid structure)
- ❖ Neck injury indicators on 800mm HR were slightly higher than 850m HR but not a big different each other.
- ❖ New cal. system shows good repeatable but the results between dummies are different. (Need further study)
- ❖ Neck injury indicators on Denton & FTSS BioRIDII are similar with each other.