At-Sea Evaluation of Ullman Cockpit

Sponsored by

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and
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R. Peterson

Ullman Cockpit

- Developed by:
  Dr. Johan Ullman
  Ullman Human Design
  Gotheburg, Sweden
- Used Exclusively by
  Swedish Coast Guard
  & Sea Rescue Institute

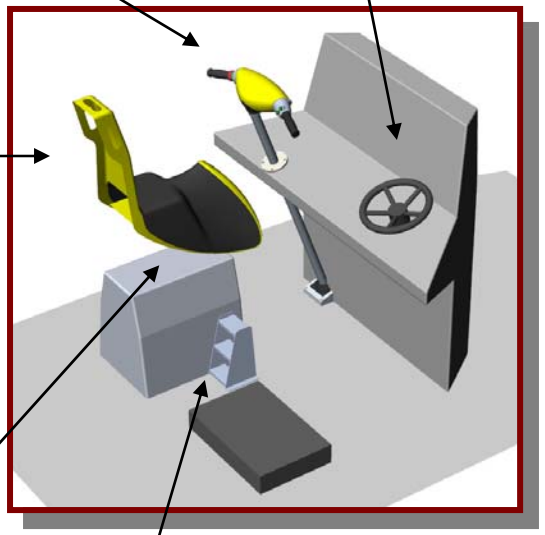
1. HANDLEBAR

- *Includes Craft Throttle and Steering Control*
- *Stabilizes Operator During Impacts*

CONVENTIONAL SEAT AND STEERING TO STARBOARD

2. SEAT

- *Includes Backrest and Cushion*
- *Positions Operator in Optimum Impact Position*
- *Also Positioned High to Allow Operator to Easily Raise Himself off Seat Just Prior to Impact*
- *Legs Absorb Portion of Impact Force (First-Stage)*



3. SPRING-DAMPER ISOLATOR

Second-Stage Absorber (after First-Stage Leg Absorption)

4. FOOT-RESTS

Placed to Position Operator in Optimum Orientation to Absorb High Level Impacts

Ullman Cockpit

Deliveries and Installations

Swedish Sea Rescue Institute 25-ft Rescue Boats

15 craft built to date with Ullman System (will be a total of 20)

Swedish Coast Guard Tender

Approx 15 craft built and delivered with Ullman System

Next Generation Tender Boat

Design Study with Waterjet, Rigid Foam Collar, and Ullman System

Latvian Coast Guard 26-ft Patrol Craft

5 craft built and delivered with Ullman System

Swedish Adventurer Mats Lindren

Atlantic Crossing, Southampton, England, to Recife, Brazil

"I wouldn't have done it without the seats"

ULLMAN COCKPIT TEST OBJECTIVES

Primary: Evaluate Shock Mitigation Discomfort and Injury Performance

- Vertical impacts
- Longitudinal and lateral impacts
- Potential for reduction in injury

Secondary: Evaluate Ergonomics

- Craft control performance (handlebar steering & throttle)
- Comfort and feeling of security
- Mobility and situational awareness

Systematic At-Sea Testing of Suspended Seats

Disturbance Environment and Seaway Measurement
- Test in "controlled wakes" and in realistic seaway
- Use wave buoy to measure wave elevation statistics

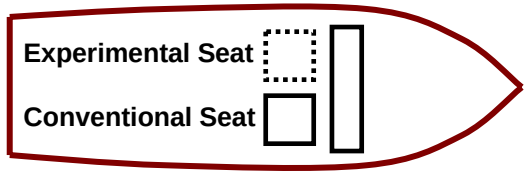
Side-by-Side Seats to Control External Variables
- Test Experimental and Conventional Control Seat simultaneously
- Mount laterally adjacent to each other, behind console
  (subjected to the same seaway disturbances)

Multiple Operators
- To control for differences in operators
- Operators swap seats periodically for comparative observations
- Analogous to shopping for speakers with "A-B comparison"

Video and Questionnaire
- Console-mounted video to capture qualitative operator dynamics
- Questionnaire to capture qualitative operator observations

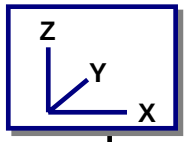
Acceleration Measurements
- Perform single measurement of boat
- Perform measurement of both seats (seat structure or "seat pan")
- Perform measurement of both human torsos

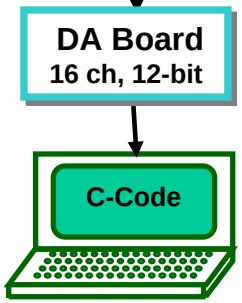
Post-processing Of Acceleration Data
- Assess potential for discomfort and injury
- Methods available (Glaister, DRI) for fully standing & fully seated
- But, Ullman & Stidd occupants neither fully standing NOR fully seated



Camera

Accelerometers





BASELINE SEATS: Stidd Systems

DESCRIPTION OF SEATS

- Primary: Stidd Systems Model 800-101v4, used in fwd area of Mk 5 SOC (days 2 & 3)
  - fold-down seat pan, height & fore/aft adjustment
  - harness, fold-up armrests

- Secondary: Stidd Systems Model 800-122 (day 1)
  - fold down seat pan, height adjustment
  - harness, no armrests

USE OF STIDD SEATS

- Primarily *standing & leaning* against "butt pad" (seat folded down)
- Grasping steering wheel and/or handholds
- Minimal use of armrests in 101v4
- Harness used in 101v4

EVALUATION METHODS

QUALITATIVE: Video and Questionnaire

- External Video from YDT
- Cockpit Video, mounted on console facing aft
- Analog-Scale Questionnaire

QUANTITATIVE: Acceleration Measurements

- Deck: CSS & UHDG
- Seat Pan: CSS, both seats
- Hip: UHDG, both occupants

At-Sea Evaluation of Ullman Cockpit

QUESTIONNAIRE AND OPERATORS

1. Shawn Martin
   USSOCOM
2. Bill Patterson
   Lockheed-Martin
3. Dave Shepard
   USCG
4. Chief Rick Tomlin
   SBU-20

Ullman Cockpit Test Questionnaire

Name: _____ Date: _____ Rank: _____

Stationed at: _____ Weight: _____ Physical Condition: _____

Phone: _____ E-mail: _____

Please rate the two seating/control systems using the following scales:

	Not at all Severe	**Vertical Impact Severity**	Extremely Severe	Comments
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

	Not at all Severe	**Lateral Impact Severity**	Extremely Severe	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

	Extremely Safe	**Feeling of Safety & Security**	Not at All Safe	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

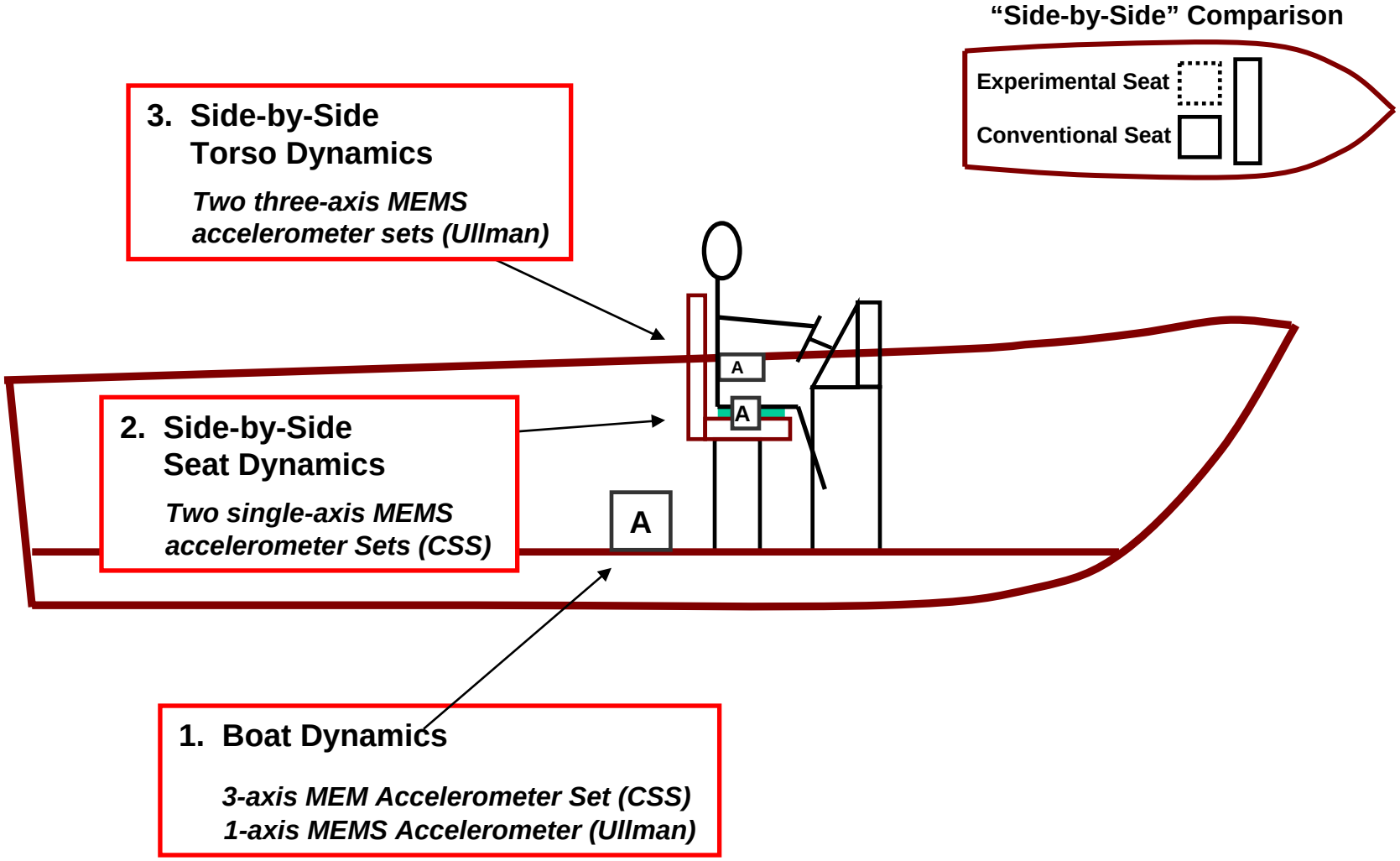
	Absolute Control	**Overall Feeling of Boat Control**	No Control	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

	Absolute Control	**Control of Steering & Throttle**	No Control	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

	Unrestricted Ability	**Ability to Perform Other Functions** (e.g. Navigate, Communicate)	No Ability	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

	Unrestricted Ability	**Ability to Change Posture**	No Ability	
Conventional	|----------		----------|	_____
Experimental	|----------		----------|	_____

Acceleration Measurements



At-Sea Evaluation of Ullman Cockpit

Ullman Cockpit Viewed from Aft

Running at Full Speed in Gulf, SS 2

11m RIB Crossing YDT Wake in Bay

Side-by-Side Testing of Ullman Cockpit and Stidd Seat

At-Sea Evaluation of Ullman Cockpit

Laptop-Based Data Acquisition System Protected by Pelican Case and Foam Support

Crossing Wake of YDT-18, 38 kt

Hip-Mounted Accelerometer

QUESTIONNAIRE RESULTS

Advantages of Ullman Cockpit

- Reduced discomfort from vertical and lateral impacts
- Improved situational awareness
- Lack of adjustments (altho adj sometimes desired)
- Ability to wear gear on back
- Improved boat control (altho problems with tested hydraulics)

Disadvantages, Deemed Fully or Partially Correctable

- Discomfort in footrests
- Insufficient padding in seat

Disadvantages, Deemed Inherent in Ullman Concept

- Feeling of insecurity
- Reduced mobility within cockpit*
- Larger deck footprint**

* not reported in questionnaire

** not reported in questionnaire; relative to stand-up bench bolsters

ACCELERATION DATA

Primary Acceleration Data: Comparative Hip Measurements

Extensive calibration and cross-checks

Three Days of Testing

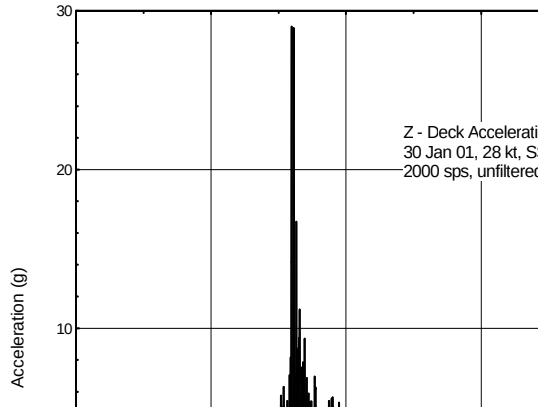
- 35 wake crossings (approx 100 impacts)
- Three hours of seaway testing (hundreds of impacts)

All time history data scanned for impacts that exceeded 3g ("hits")

Result: 28 hits on day 1
18 hits on day 2
34 hits on day 3

CSS DECK DATA

Raw: 2000 sps

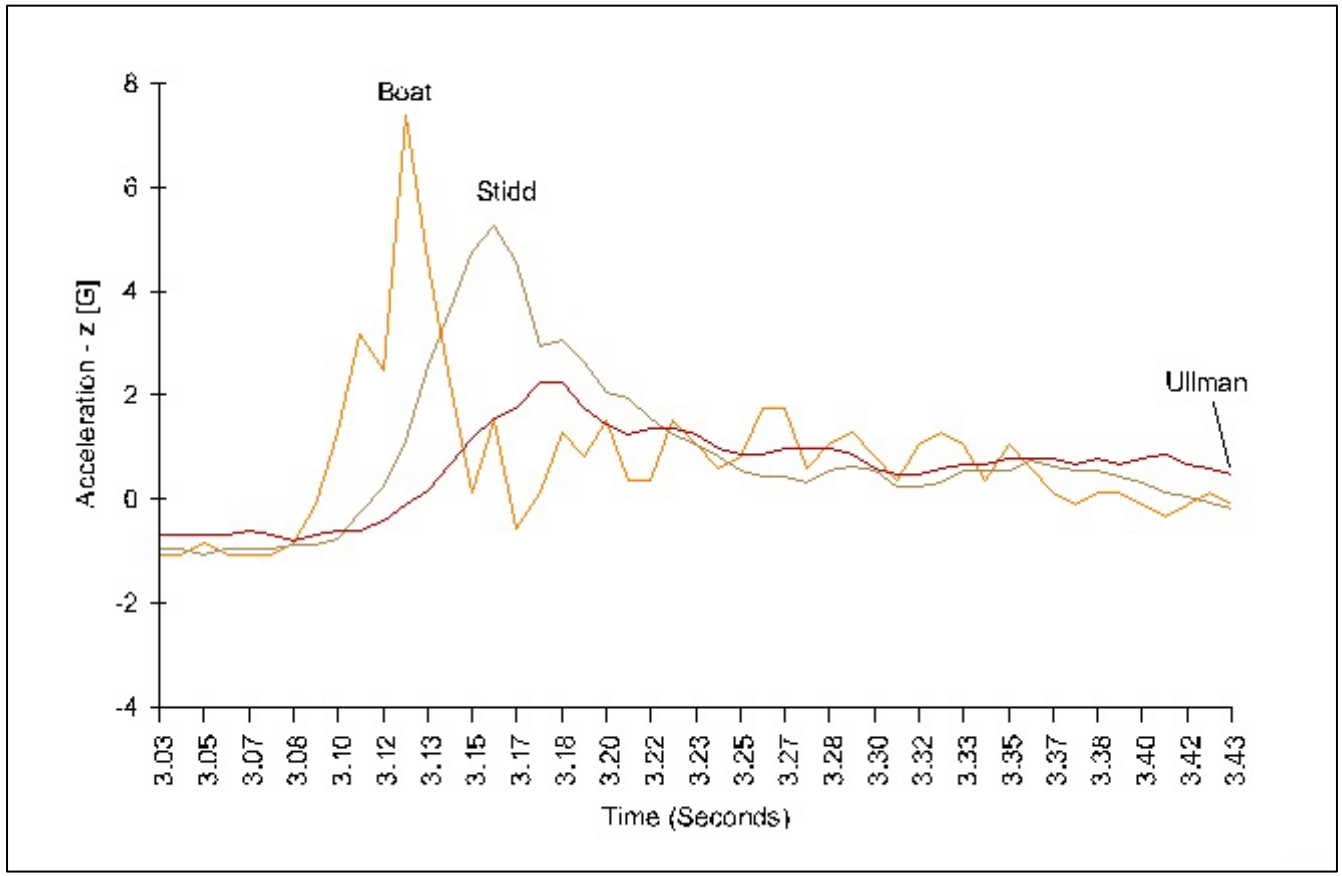


Filtered at 100 Hz

At-Sea Evaluation of Ullman Cockpit

Deck, Stidd Hip, Ullman Hip Waveforms

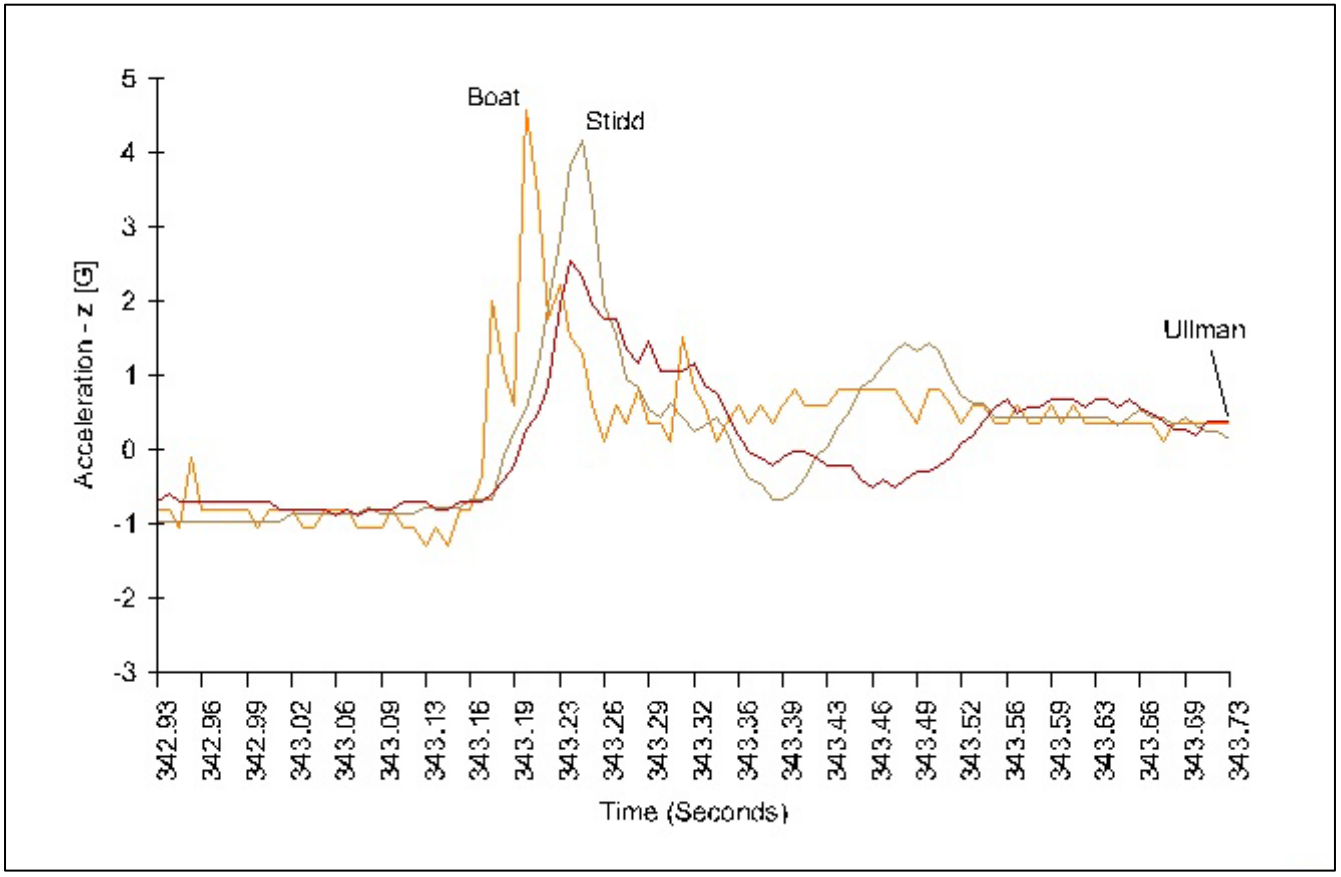
F2, Day 1, Wake, SM-Stidd, BP-Ullman



At-Sea Evaluation of Ullman Cockpit

Deck, Stidd Hip, Ullman Hip Waveforms

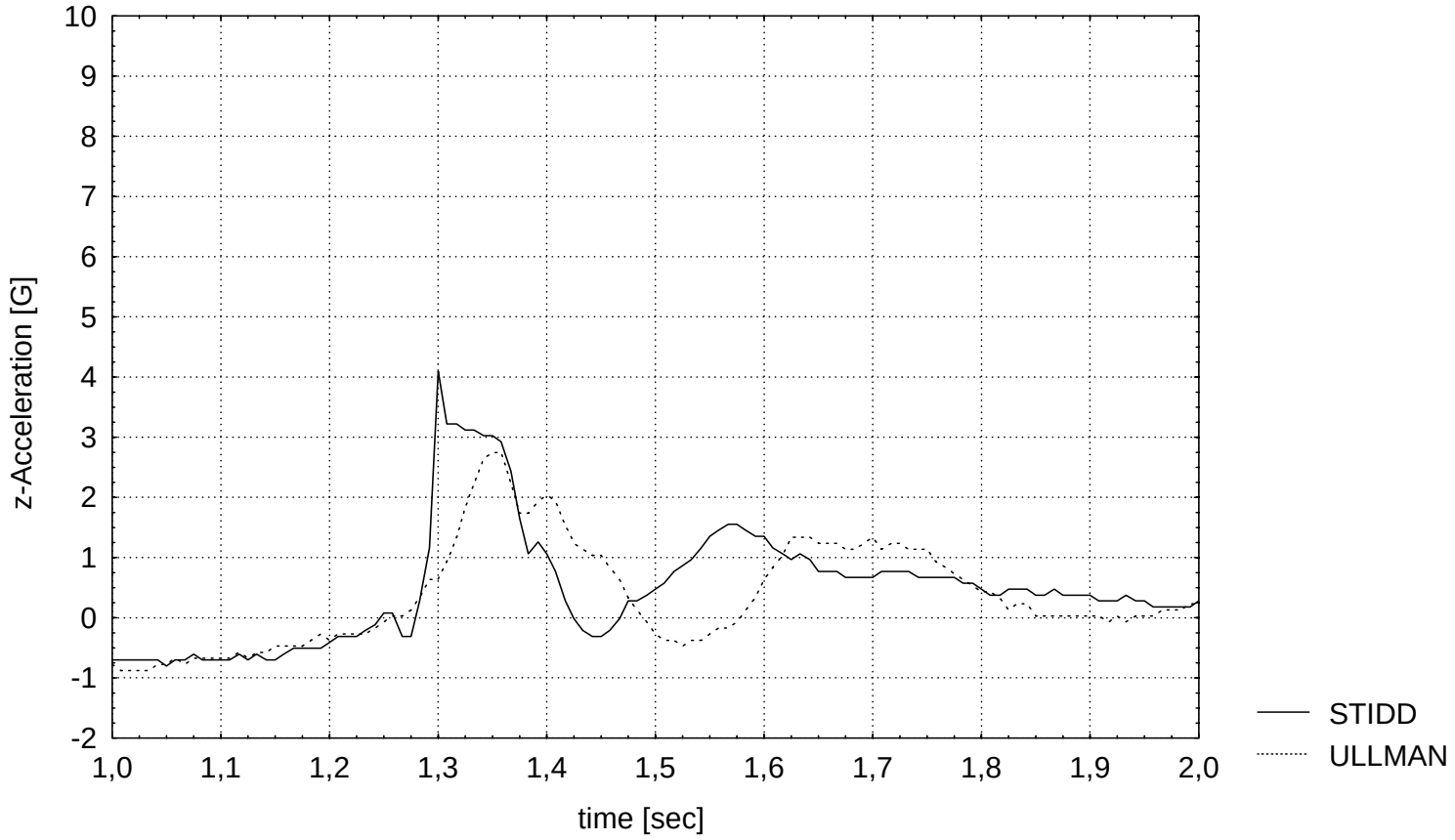
F3, Day 1, Wake, SM-Stidd, BP-Ullman



At-Sea Evaluation of Ullman Cockpit

Stidd Hip, Ullman Hip Waveforms

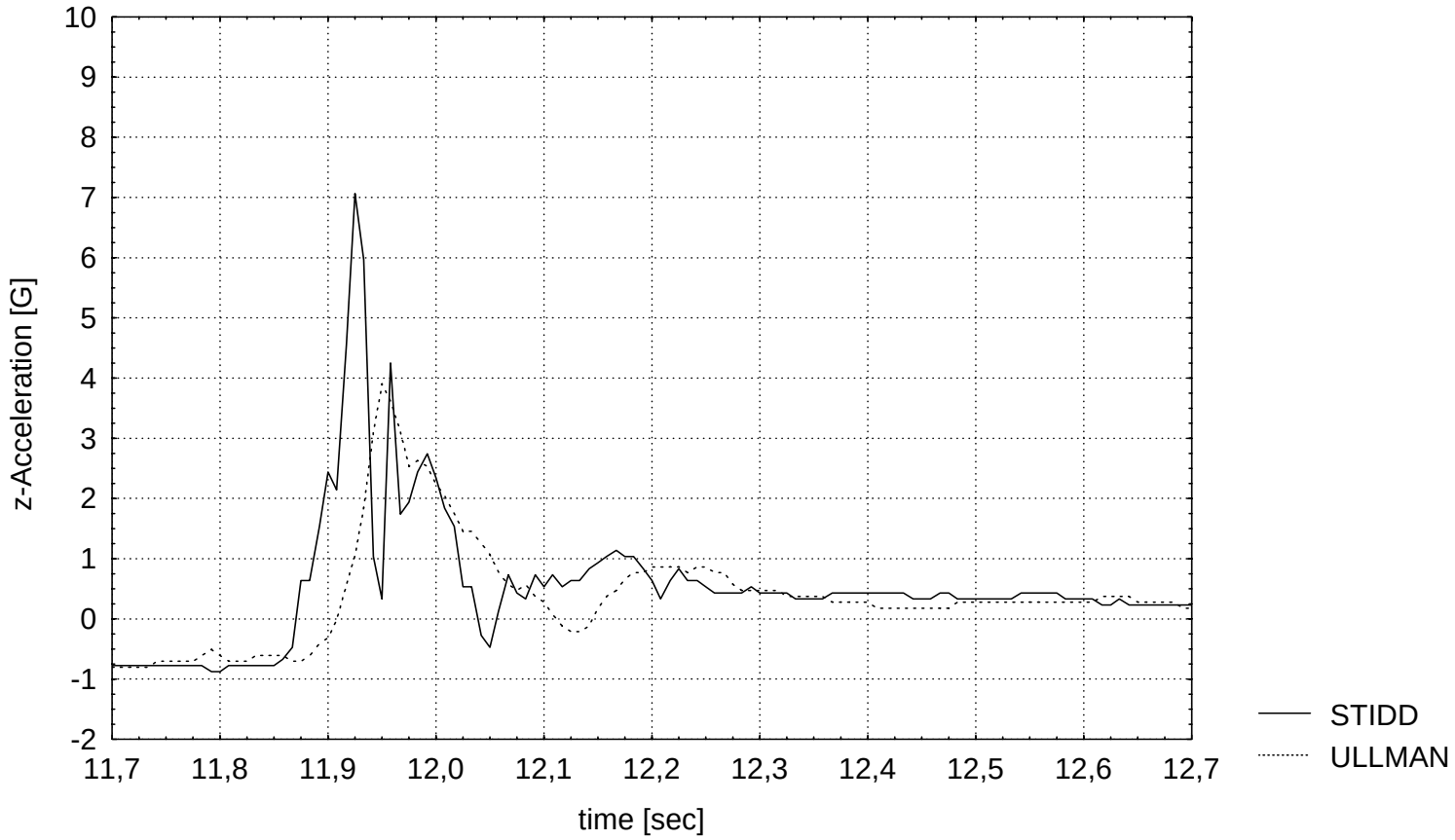
F7, Day 2, Wake, RR-Stidd, RT-Ullman



At-Sea Evaluation of Ullman Cockpit

Stidd Hip, Ullman Hip Waveforms

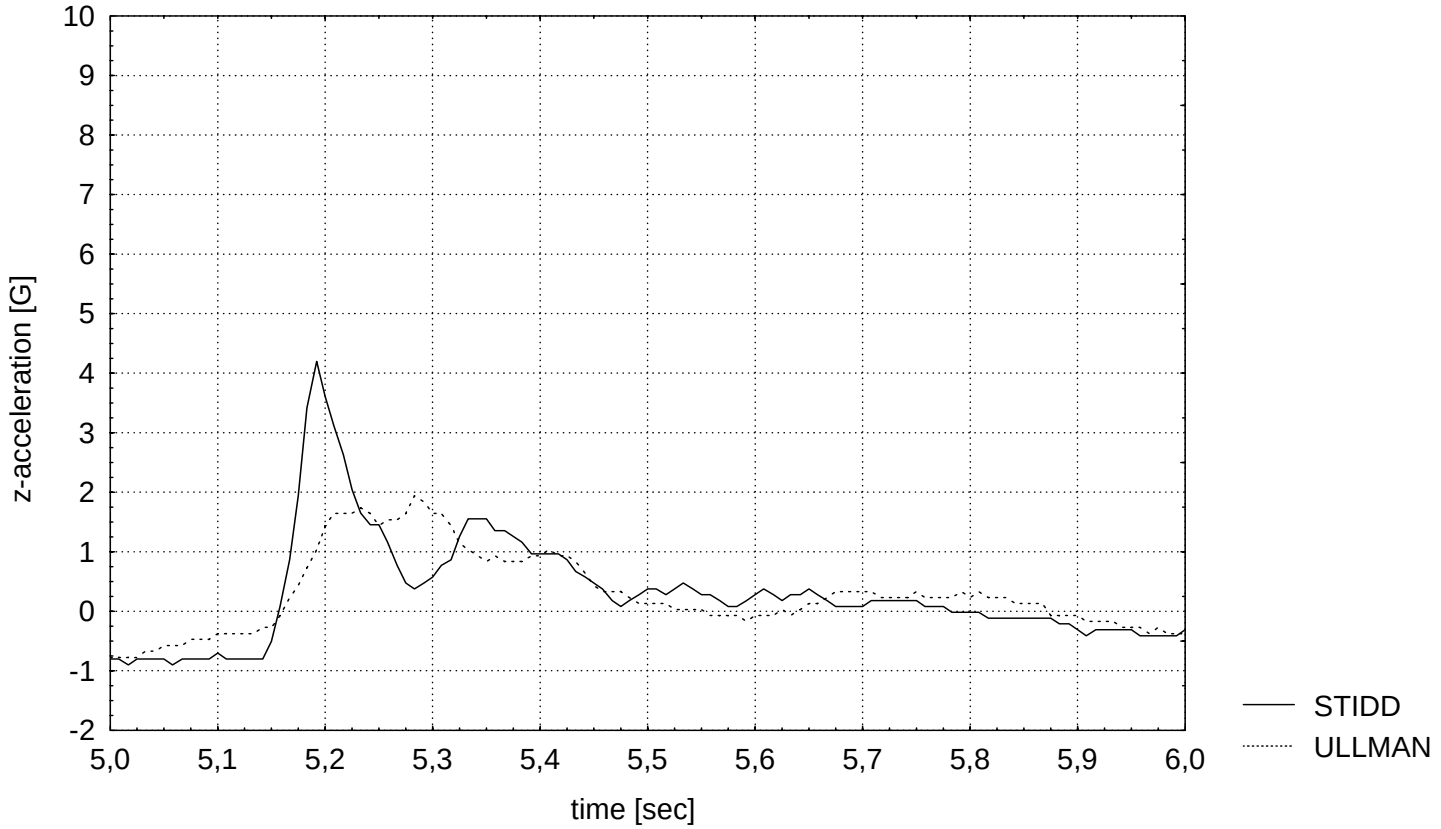
F8, Day 2, Wake, RT-Stidd, RR-Ullman



At-Sea Evaluation of Ullman Cockpit

Stidd Hip, Ullman Hip Waveforms

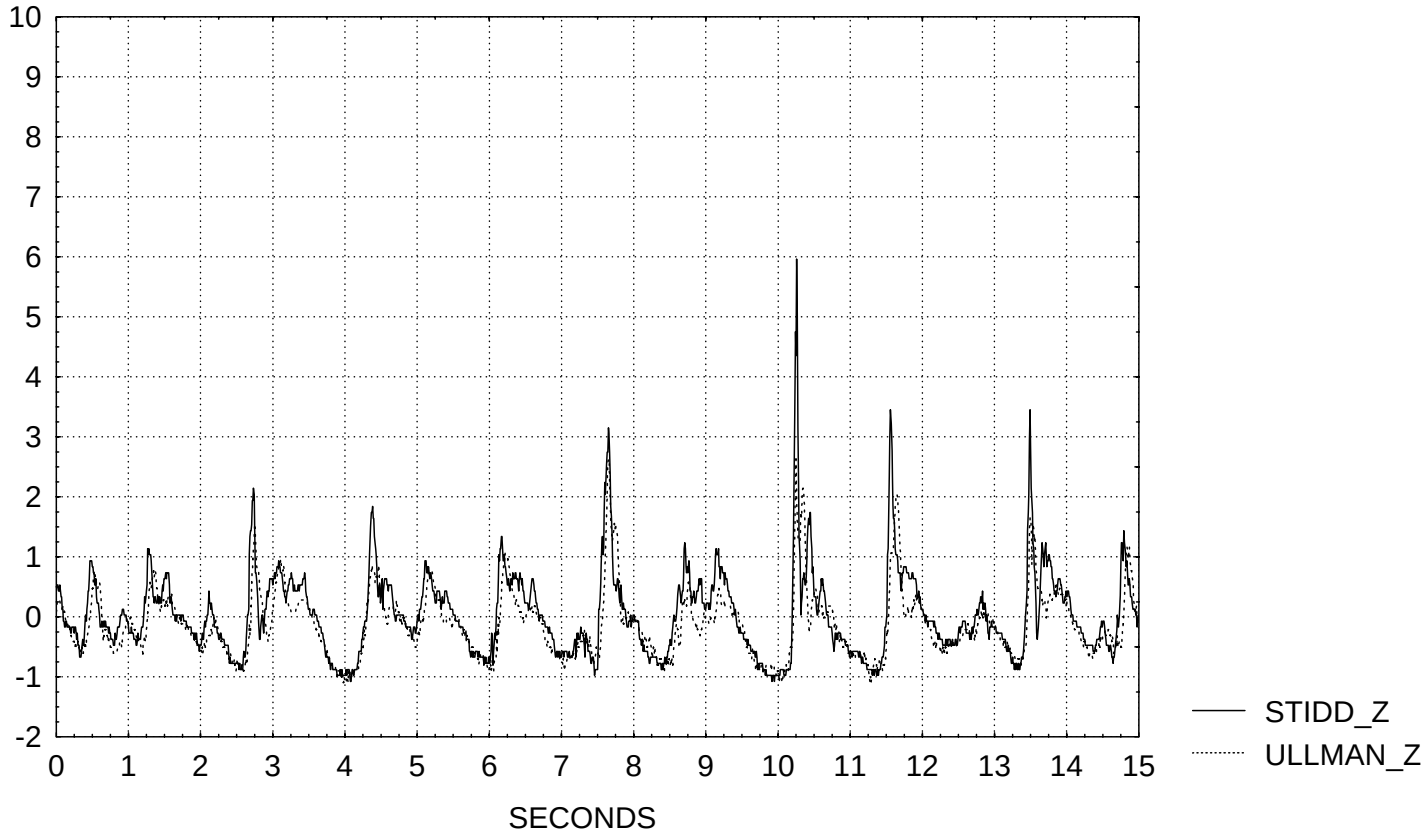
F9, Day 2, Wake, RR-Stidd, RT-Ullman



At-Sea Evaluation of Ullman Cockpit

Stidd Hip, Ullman Hip Waveforms

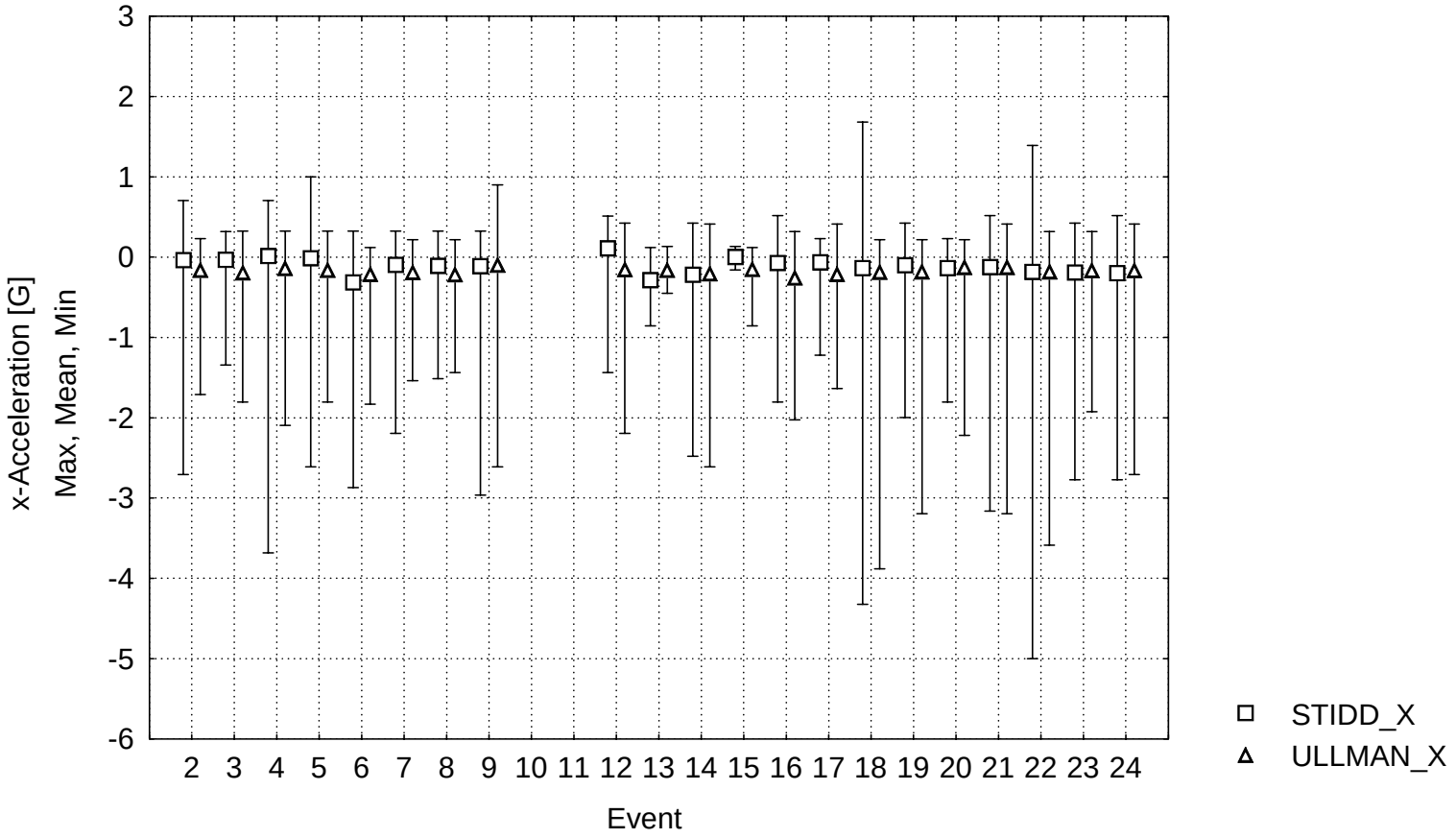
F11, Day 3, At-Sea, RT-Stidd, DS-Ullman



At-Sea Evaluation of Ullman Cockpit

Surge Acceleration Statistics

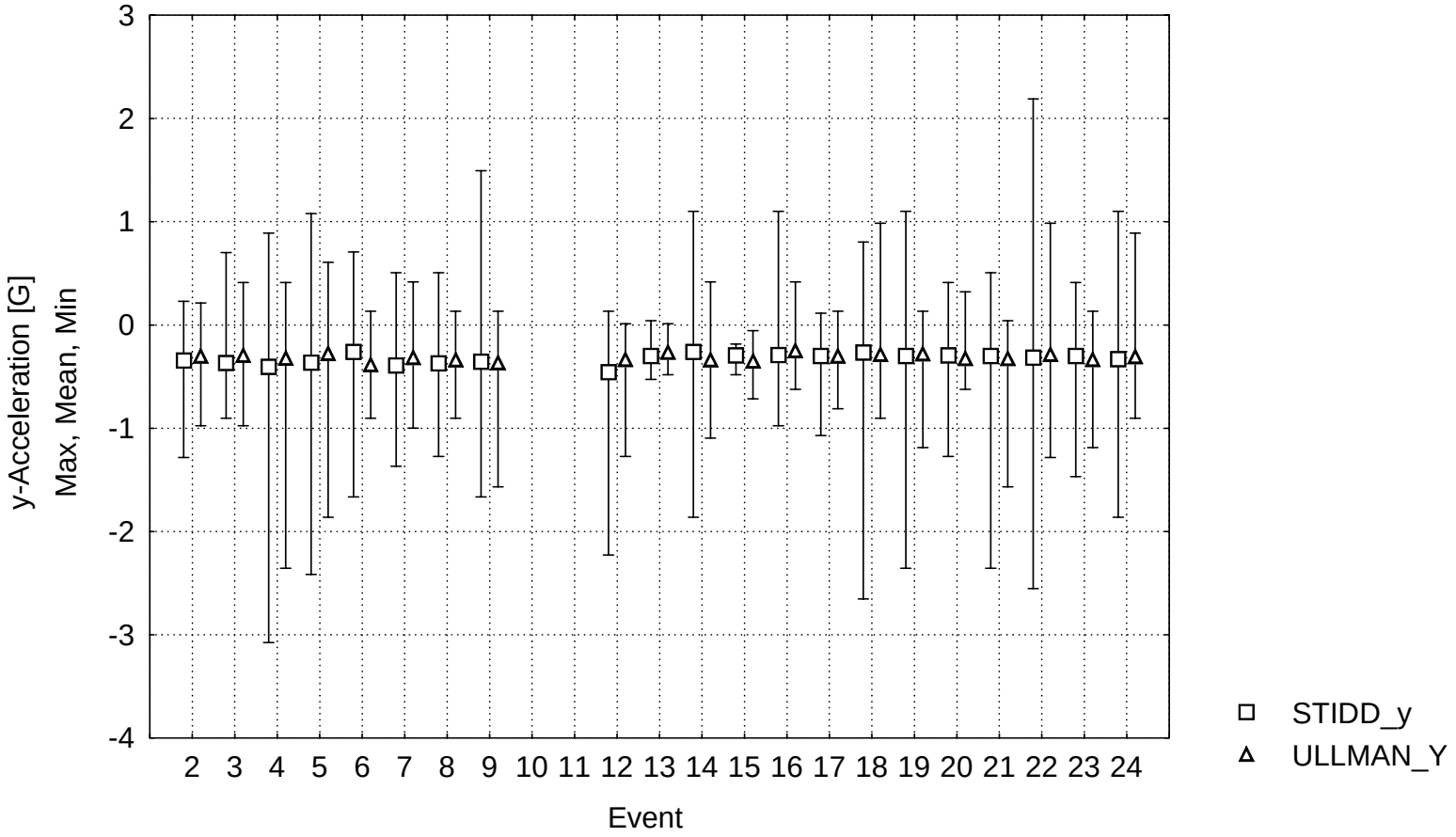
F4, Day 2, Wake & Seaway



At-Sea Evaluation of Ullman Cockpit

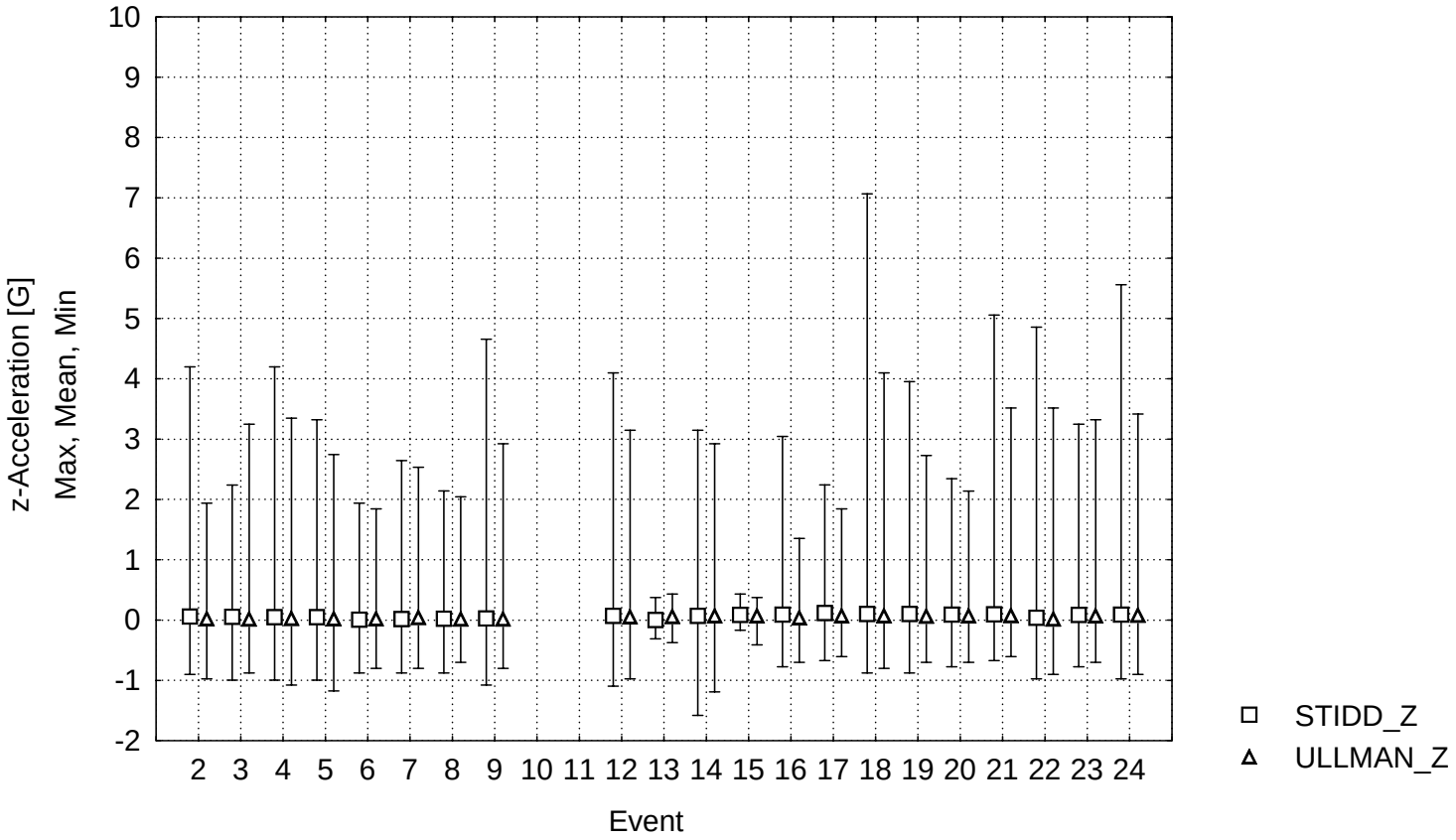
Sway Acceleration Statistics

F5, Day 2, Wake & Seaway



Surge Acceleration Statistics

F6, Day 2, Wake & Seaway



Stidd-Ullman Vertical Acceleration Statistics Summary

All Three Days, Wake & Seaway
80 Events with Greater Than 3g

Data Group	Stidd Seats			Ullman Seat			Difference in Mean	
	N	Std.Dev.	Mean	N	Std.Dev.	Mean		
Day 1, AM, Crossings	16	0.94	3.06	16	1.12	3.66	0.61	19.8%
Day 1, PM, Crossings	12	0.91	4.82	12	0.58	2.39	-2.43	-50.3%
Day 2, Crossings and Seaway	18	1.07	4.16	18	0.62	3.02	-1.14	-27.4%
Day 3, Seaway	34	1.40	4.04	34	1.23	2.93	-1.10	-27.3%
Weighted Average	80	1.16	3.98	80	0.98	3.02	-0.97	-24.3%

RESULTS OF HIP ACCELERATION DATA ANALYSIS

FINDINGS

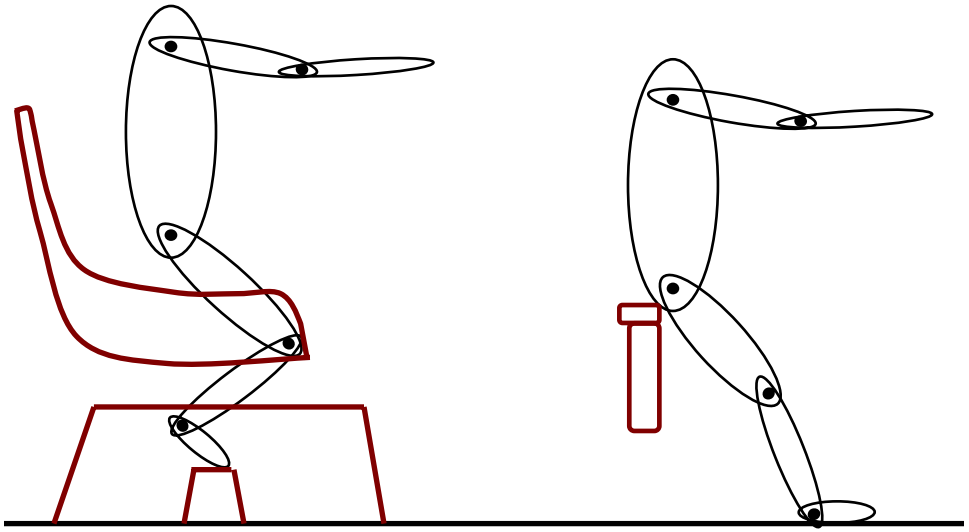
- Acceleration data consistent between day 1pm, 2, & 3
- Higher frequency content in Stidd seat
- Stidd hip accelerations similar to deck data
- Ullman max vertical impact magnitudes significantly lower
- "Rise time" consistently lower in Ullman data

HOWEVER...

- Both occupants were in "complex" postures (relative to free standing or firmly sitting)
- Endorsed capability for predicting discomfort & injury from the waveforms, for these postures, DOES NOT EXIST
- But Ullman occupants reported less discomfort, and the data strongly suggests a similar result

At-Sea Evaluation of Ullman Cockpit

Why are Ullman Hip Acceleration Magnitudes Lower?



- Angle of knee flexion
  - Inability of Stidd occupant to flex knees continuously
  - Inability of Stidd occupant to bend knee just prior to impact
- Position of Ullman CG relative to footrest
- Ball of Ullman occupant on footrest

Flexible vs. rigid system

CONCLUSIONS

Tested Ullman Cockpit (a "hybrid" seat/posture) concept against two conventional rigid seats that were used as stand-up bolsters

- Ullman Cockpit Advantages
  - Improved comfort and reduced impact magnitudes
  - Improved situational awareness
  - Improved boat control (subject to further evaluation)

- Ullman Cockpit Limitations
  - Some reported feeling of lateral insecurity
  - Mobility within cockpit is an issue
  - Lateral deck footprint is an issue

- Fatigue Issue
  - Especially after hours of operation, standing/leaning occupants become extremely fatigued, and make mistakes
  - Occupants can SIT in Ullman seat