

Humanetics Innovative Solutions, Inc.



Flex PLI Test Fixture
SN05 Dynamic Testing

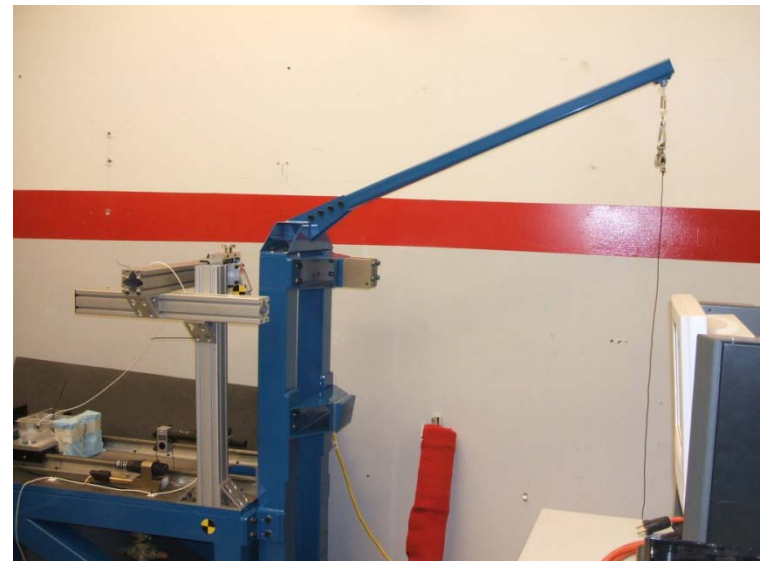
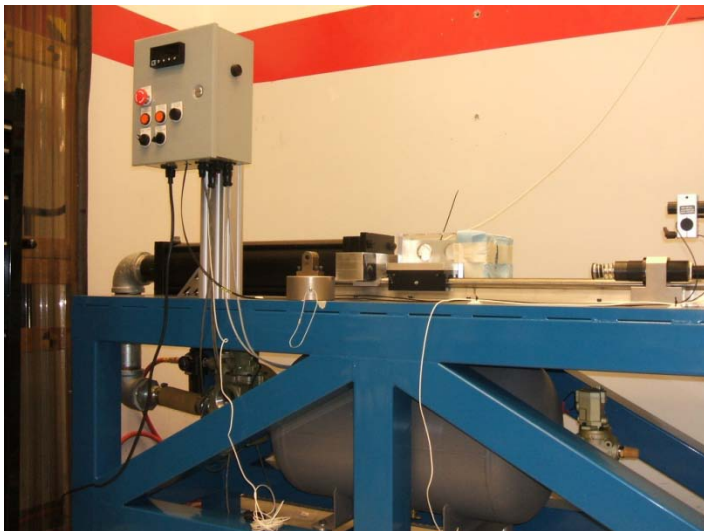
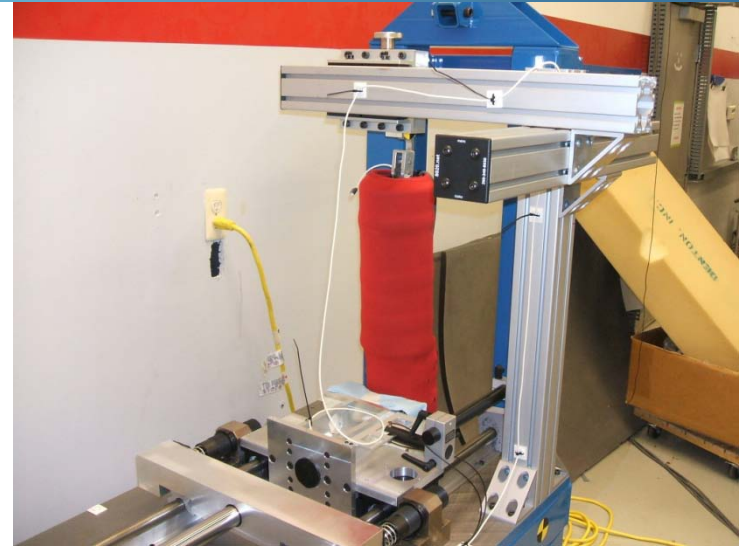
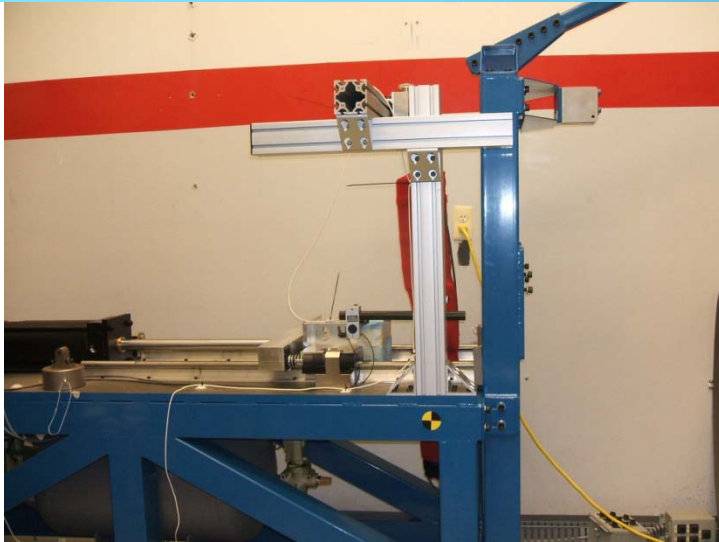
Instrumentation Engineering

July 18, 2012

Introduction

- ▶ Testing carried out to confirm new rig setup before RR leg testing
- ▶ Leg was built and prepared to new agreed build level as per RR legs
- ▶ Pendulum tests were carried out on integrated fixture with inverse
- ▶ Testing was performed in the test lab where the fixture is bolted to the floor
- ▶ Inverse ram configuration
 - Mass = 8.1kg without Honeycomb
 - Acceleration distance = 580mm
 - Free Travel distance = 70mm
 - Leg impact to stop distance = 200mm

HIS Combined Inverse and Pendulum Rig



Results of SN05 Testing

Inverse Impact Data

	Velocity	Tibia 1	Tibia 2	Tibia 3	Tibia 4	ACL	MCL	PCL	LCL	Femur 1	Femur 2	Femur 3	Knee	Ram Accel	Tank PSI
Upper Corridor	11.30	277.00	269.00	204.00	120.00	10.50	23.00	6.0							
Lower Corridor	10.90	237.00	223.00	176.00	98.00	8.50	18.00	4.5							
Prop JARI Upper		270.96	256.18	193.21	112.17	9.8	21.81	5.68							
Prop JARI Lower		230.96	210.18	165.21	90.17	7.8	16.81	4.18							
Prop BAST Upper		272.0	252.0	192.0	108.0	10.0	21.0	6							
Prop BAST Lower		230.0	210.0	166.0	93.0	8.0	17.0	4							
05-8	10.82	258.5	229.4	177.2	103.1	8.8	19.0	2.8	5.1	197.3	144.4	114.9	273.2	167.9	59.9
05-9	10.81	249.0	220.9	171.1	98.0	9.7	20.1	2.8	5.2	206.5	150.8	110.8	277.6	164.5	59.9
05-10	11.23	254.4	230.0	177.9	100.8	9.0	20.9	2.8	5.6	211.2	151.9	115.1	259.9	165.4	60.0
05-11	11.29	254.7	230.5	176.3	99.5	9.3	21.0	2.8	5.5	211.6	154.8	112.9	258.9		61.2
05-12	10.88	245.1	223.1	171.0	95.2	9.3	19.3	2.8	4.8	198.4	145.2	112.4	262.8		59.2

Pendulum Data

	Knee Accel	Tibia 1	Tibia 2	Tibia 3	Tibia 4	ACL	MCL	PCL	LCL	Femur 1	Femur 2	Femur 3
Upper Corridor	72.90	235.00	211.00	160.00	108.00	11.00	26.00	5.4				
Lower Corridor	48.10	272.00	185.00	135.00	94.00	9.00	23.00	4				
JARI Upper		272.53	216.84	167.25	111.87	9.97	24	5.15				
JARI Lower		235.37	190.92	142.04	97.28	8.11	20.83	3.81				
BAST Upper		272.0	219.0	166.0	111.0	10.5	24.0	5.0				
BAST Lower		235.0	187.0	139.0	90.0	8.0	20.5	3.5				
05-1	63.8	248.1	201.0	152.9	103.8	9.5	20.2	4.0	4.1	185.6	135.3	87.3
05-2	65.7	247.5	200.3	152.1	103.2	9.6	20.2	4.1	4.1	184.1	133.5	85.6
05-3	64.8	248.2	201.0	152.6	103.5	9.7	20.2	4.1	4.1	184.6	133.7	85.5
05-4	66.1	249.1	201.7	153.2	103.9	9.8	20.2	4.1	4.2	185.2	134.0	85.7
05-5	67.3	248.8	201.4	153.0	103.7	9.8	20.2	4.1	4.1	184.9	133.4	85.2
05-6	68.3	248.7	201.2	153.0	103.8	9.8	20.2	4.1	4.1	184.8	133.2	84.9
05-7	67.0	248.8	201.6	153.4	103.9	9.7	22.4	4.0	4.2	184.4	132.7	84.8

SN05 Results Overview

- ▶ Passing all parameters in Pendulum test
 - MCL was low (2.6%) from original corridor but passing new proposed corridors
 - SLICE MCL data channel offset was set poorly. Only Pendulum test 7 is accurate.
- ▶ Passing in Inverse test
 - PCL pot appeared to be saturated due to problem with assembly process.

TF-RUCC Rig Concerns

- ▶ No movement was noticed on rig prior to impact, high speed video would verify this.
- ▶ Speed measurement taken over one vane 20 KHz sample rate. Speed measured in 70 mm free motion of stroke, speed recorded at centre of trapezoid signal. We do not believe at this high speed accuracy is affected by having the vane attached to the rig.

Conclusions

- ▶ An additional leg (SN05) prepared to new RR spec passed the proposed inverse and pendulum corridors although one channel on each test had a problem. The pendulum channel problem was resolved.
- ▶ Both inverse and pendulum showed good repeatable results consistent with other labs

Thank You!