STUDY INTO COMPARATIVE DIFFERENCES OF SCIENTIFIC TESTING MACHINES USED IN ALPACA FIBRE MEASUREMENT

A Report to the Australian Alpaca Association

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STUDY INTO COMPARATIVE DIFFERENCES OF SCIENTIFIC TESTING MACHINES USED IN ALPACA FIBRE MEASUREMENT

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RATIONALE

Objective measurement of alpaca fibre is now an integral process in the showing, breeding, marketing and classing of alpacas and alpaca fibre. Four systems are in common use, those being the OFDA and Laser systems in their laboratory and shed configurations. This study aims to test the comparability of those techniques in measuring alpaca fibre, and thereby validate their use in comparing fibre measured by different techniques.

OBJECTIVE

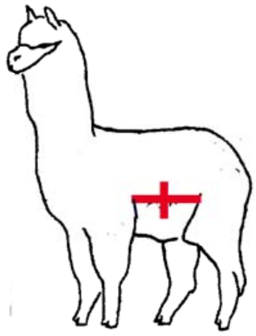
1. Identify 50 suitable alpacas of various types for assessment. The alpacas should be mixed in origin eg. Chile/Peru background.

2. Machines to be used in this study

   - OFDA 100 (laboratory): OL
   - OFDA 2000 (In shed): OS
   - LASER SCAN (In shed): LS
   - LASER SCAN (Laboratory):LL

3. Site sample, using the format developed by Cameron Holt for show fleece measurement (6 position grid site sample), of skirted huacaya fleece.

4 Midside all alpacas as per diagram (site selected based on study by C. Holt and I. Stapleton (1992). This sample to be tested on OFDA 100 (in lab system).



5. All grid site samples (except midside) to be subsampled into 3 groups to form a composite test sample from each alpaca. Those samples to be tested by OL, OS and LL systems by three selected testing houses.

6. The remainder of the skirted fleece to be sent to a venue where a laser scan "in shed" (LS) system will be used.

SUMMARY OF RESULTS

INTRODUCTION

By way of background, it should be understood that:

1. OFDA100 and LASER (LAB) machines used in this experiment have been approved for fibre measurement.
2. No two testing machines will give exactly the same results, particularly between different types of equipment, although if machines are approved they will be within acceptable tolerance.
3. No two-fibre samples are exactly the same.
4. The grid sample is taken from a skirted fleece and the midside sample is taken from an unskirted fleece (note position on alpaca) and therefore a slightly coarser micron would be expected in the midside sample.
5. The Laser Inshed technique is suitable only for whole fleeces.

Comparisons were made between (in order of the graphs presented later in the paper)

1. The grid sample measured by OL and OS
2. The grid and midside samples, both measured by OL
3. The grid and midside samples, both measured by OS
4. The grid sample measured by OL and the midside measured by OS
5. The midside sample measured by OL and OS
6. The grid sample measured by LL, and the whole fleece core testing by LS
7. The grid sample, measured by OL and LL

Due to some variances in the results obtained by testing the grid samples by OL and OS (1), it was decided to use the "keeper sample" of the midside to run a further comparison between OL and OS (5).

REPORT

1. When comparing the grid samples of OFDA 100 lab and OFDA 2000 in shed there was a large variation with a mean magnitude of difference (MMD) of 1.1 microns. After discussions with operators of the OFDA 2000 this difference was considered to be due to the preparation of the subsample required for testing.

   INFERENCE: Subsampling a grid sample is likely to produce considerable variation in the composition of the subsamples, and the sampling technique is more likely to be responsible for the wider variation in these results than the accuracy of the machines measuring them.

2. Comparison of the grid sample and the midside sample, both measured by the OFDA 100 (lab), shows a bias three times the standard error, which was significant. This probably reflects the midside sampling on an unskirted fleece and grid sampling on a skirted fleece. The mean magnitude of difference (MMD) was 0.87 microns and showed a consistent scatter when plotted.

   INFERENCE: The grid sample was finer than the midside sample when both samples were tested on the OFDA 100 (lab). This is a real difference that is determined by the sampling methods (midside on alpaca / grid on skirted fleece).

3. Comparison of the grid and midside samples, both measured by the OFDA 2000 (shed), showed a large scatter and had a large MMD of 1.26 microns. It is considered that a single site sample (midside) was more reliable than the grid due to possible subsampling errors in the latter. Refer to methods of test houses – OFDA 2000.

   INFERENCE: As noted in (1) above, the technique of subsampling the grid sample is the likely cause of the wide variation between the midside measurements and the grid *measurements, and is a reflection of the unreliability of that subsampling technique for a gridded sample.*

4. Comparison of the grid samples measured by OFDA 100 (lab) and the midside samples measured by OFDA 2000 (shed) revealed a MMD of 0.82 microns.

   INFERENCE: Measurements taken on grid samples (skirted fleece) measured by OFDA in the lab, with midside samples measured by OFDA in the shed, are two separate populations. The midside is representative of an unskirted fleece (this implies that parts of the middle leg areas of the fleece are included), whereas the skirted fleece has had the coarser areas removed.

5. The comparison of midside samples measured by the two OFDA techniques, in lab and shed, showed a very tight scatter, with microns (between compatible samples) being within a 2 micron difference. The slope is significantly less than one to one, which may indicate a difference in performance between the individual machines. The opinion is that measurement of a midside (single site) by the OFDA 2000 is validated.

   INFERENCE: This is a validation of the OFDA in-shed technique for the measurement of midside samples.

6. The comparison of the Laser (shed) technique, applied to a whole skirted fleece, and the Laser (lab) technique, applied to a grid sample of the same fleece, demonstrated a reasonable correlation between the two, with a very slight bias to fineness in the former. Scatter was minimal, allowing for two outliers, with an overall MMD of 0.90 microns. Coring, turning the fleece and re-coring the fleece, may reduce this difference in fineness, when using the Laser (shed) technique.

   INFERENCE: Comparison of measurements taken on a whole fleece measured by Laser in the shed with those taken on a grid sample by Laser in the lab, is valid.

7. Finally a comparison of the measurements made on a grid sample by OFDA 100 (lab) and Laser lab was made. The MMD was 0.95 microns with a consistent tight scatter. The laser consistently gave a lower micron reading by a factor of 0.87.

   INFERENCE: This validates the alternative use of OFDA or Laser lab techniques in measuring a given fleece sample, though the Laser overall in this trial was inclined to give results slightly biased to fineness. Other trials have shown these machines to produce consistent and compatible results.

8. It was noticed that between the OFDA and laser machines a large difference for curvature was observed (17.82 degrees per mm). The laserscan was the higher (average curvature 53.39 degrees per mm) compared to the OFDA (35.58 degrees per mm).

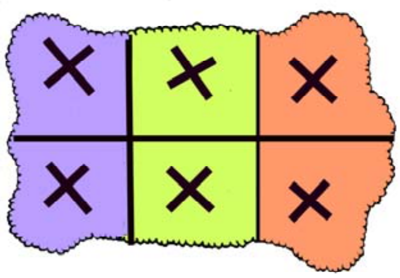
   INFERENCE: The correlation between curvature measured by OFDA or laser for any one sample is poor, with OFDA measuring significantly lower curvature than Laser. The significance of difference in curvature measurements between machines, suggests that meaningful comparisons of fibre curvature between different fleeces can only be made if measured by the same techniques.

MATERIALS AND METHODS ---- SAMPLING

PRE SHEARING PROCEDURE

1. Select 50 suitable animals.

2. Identify midside site and sample meticulously prior to shearing. Place sample in plastic bag with identification of animal number and notation that this is a midside sample.



3. Whilst shearing, alpaca identification number to be recorded on tag, which goes with fleece to skirting table.

4. Spread out fleece on table and skirt. Imagine the fleece in 6 sections. Site sample from the nominated 6 positions, taking 6 staples from each of those positions.

5. Have a table that is clearly marked out in same scheme and place each of these samples in its position.

6. From the 36 staples (6 staples for each of six sites), randomly create 3 grid samples, each comprising 12 staples, made by selecting two staples from each of the 6 sites. Place each of the three grid samples in a separate plastic bag. Clearly mark the animal number on each bag and include label inside. Mark one of each of the three bags with OL, OS or LL.

7. Collect all bags from all 50 alpacas, and sort into OL, OS or LL.

8. These bags should be placed in larger plastic bags and sent to the appropriate testing laboratory as required with necessary paper work.

9. Tests to be done are -

   OFDA 100 (Using mini core in laboratory)
   Micron, CV, SD, Curvature and Medullation

   OFDA 2000 (In shed procedure)
   Micron, CV, SD, and Curvature

   LASER SCAN
   Micron, CV, SD and Curvature

10. The remaining fleece should be placed in a large plastic bag with identification number, prior to despatch to a testing house utilising the **laser scan "in shed" format**.

    Tests to be done are –
    Micron, CV, SD and Curvature.

11. The **midside samples** are to be split into two groups and one group sent to a laboratory using

    OFDA 100 to be mini cored.
    Tests are for *micron, CV, SD, Curvature and Medullation*.

13 The second group of **midside samples** are to be kept as a "keeper sample"

METHODS OF TEST HOUSES

OFDA 100 Lab
This machine is regularly calibrated using standardised tops and commercial wire slides developed for this procedure.
A sample is received and identified and is sub sampled using mini core equipment. The 2 mm snippets are then scoured and dried. The sub sample re conditions for 8 hours prior to being measured on the OFDA 100.
Standard humidity 65%, + - 2% and temperature 20 degrees Celsius + - 2 degrees.

OFDA 2000
The alpaca settings are engaged on the machine, polyester calibration slide is run through which is set at 18.6 microns. The grease correction factor for alpaca is then selected (21.7 micron greasy and 21.4 micron clean – 0.3 micron correction factor).
From the sample, which has been received and identified, the operator will take one staple of finger width from the centre of the gross sample. This was done for both the grid sample and the midside sample. The staple selected is then spread out with the tip to the top of the slide ready for measurement by the OFDA 2000 (there is no scouring for this test).

LASER SCAN LABORATORY
Using normal laboratory settings the sample is received and identified. It is then placed in a mini core system and the snippets are then scoured. When this process is finished the snippets are then placed into the liquid solution in the laser scan and measured. Standard humidity 65%, + - 2% and temperature 20 degrees Celsius + - 2 degrees.

LASER SCAN INSHED

This testing is carried out in a semi automatic process. When the fleece is received it is identified and placed in the coring bin for sub sampling. The snippets that have been taken are then washed and dried and placed in the liquid solution of the laser scan for testing.

RECOMMENDATIONS

GENERAL

Following the comparison of results of the OFDA 2000 (grid sample) discussions took place with the operator of the laboratory concerned re sub sampling methods and also with management of IWG (agents for the OFDA 2000) and it is jointly recommended that

1. Grid samples must be clearly identified as such.
2. Grid samples to be tested on the OFDA 100 or OFDA 100 mode of the 2000 until satisfactory sub sampling methods are put in place for use on the 2000.

Following discussions with the operators of the in shed laser scan regarding the 2 outliers it is recommended that due to the large variation generally found in alpaca across the whole fleece it is recommended that two corings of the fleece be carried out to improve the sub sample.

BREEDERS

It is recommended to alpaca breeders that

1. Any sample being sent for testing at any test house should clearly identify whether it is a mid or grid sample.
2. Grid samples (at this stage) are not tested using the OFDA 2000 method until a satisfactory sub sampling method is invoked.
3. If measuring and recording curvatures, breeders should select and stick with one or other of the OFDA or laser format due to the variances in recording by these machines.

ORGANISERS OF ALPACA FLEECE SHOWS

Where measurement is required and the 6-point grid procedure is used, the following options should be implemented.

1. Send samples to a laboratory that is using an OFDA 100 or 100 mode, **OR** . . ..
2. Send samples to a laboratory that is using the laser scan, **OR** . . .
3. Engage operators of the laser scan inshed system where fleeces are cored on site. Note – it is recommended that double coring take place to improve the sub sample that is used for testing.

FURTHER READING

Components of Alpaca (Lama Pacos) fleeces and the potential of inshed measurement of fibre diameter.
A.C. SCHLINK & A.M. MURRAY CSIRO Livestock Industries, W.A.

Performance of the OFDA 100 compared to other instruments –
IWG (Interactive group), Fremantle W.A.

Fleecescan and OFDA 2000 Trial
Andrew Peterson, Agricultural Department, W.A.

OFDA2000 Proficiency trials
Peter Baxter, Bill Johnston. IWTO Report no CTF 01 2002

Special thanks to Professor Brian Sawford (Monash University) for his help in calculating and analysing the results of this study.

RESULTS

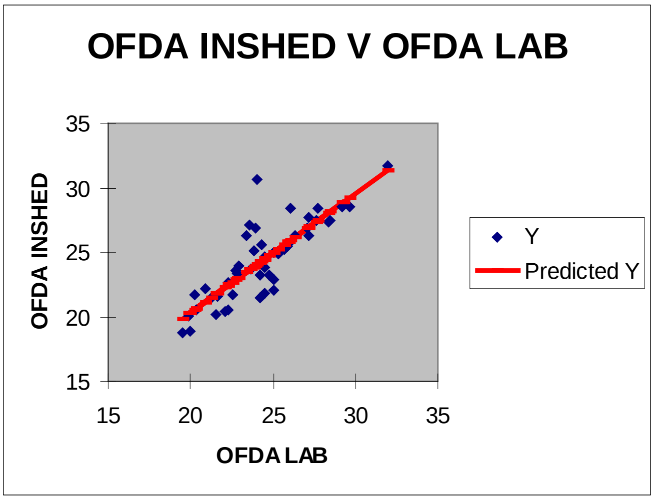
DATA

COMPARISONS		MEAN MAG OF DIFF	S D	AVE DIFF	STD ERROR OF AVE DIFF	BASE AVE MIC (X)	OTHER AVE MIC (Y)	BASE ave Finer/ Coarser Than other	R SQ	INTERCEPT		X SLOPE	
BASE (X)	OTHER (Y)									CO-EFF	STD ERROR	CO-EFF	STD ERROR
OFDA LAB GRID	OFDA INSHED GRID	1.165	1.694	-.011	0.24	24.51	24.50	C 0.01	0.7078	1.8747	2.1337	0.9230	0.0865
OFDA LAB GRID	OFDA LAB MID	0.876	1.080	.435	0.15	24.51	24.94	F 0.43	0.8826	-0.5553	1.3652	1.040	0.0553
OFDA INSHED GRID	OFDA INSHED MID	1.265	1.758	.232	0.25	24.50	24.73	F 0.23	0.6927	5.4532	1.8871	0.7867	0.0764
OFDA LAB GRID	OFDA INSHED MID	.820	1.075	.219	0.15	24.51	24.73	F 0.22	0.8673	1.0549	1.3592	0.9658	0.0551
OFDA LAB MID	OFDA INSHED MID	.706	0.888	-.216	0.13	24.94	24.73	C 0.21	0.9203	2.3164	0.9688	0.8984	0.0385
LASER LAB GRID	LASER INSHED FLC CORE	.901	1.112	-.344	0.16	23.72	23.38	C 0.34	0.8198	2.685	1.423	0.8722	0.0596
OFDA LAB GRID	LASER LAB GRID	.952	0.841	-.785	0.12	24.51	23.72	C 0.79	0.9133	2.2683	0.9701	0.8754	0.0393

MACHINE USED	AVE MIC	AVE CV	AVE CURVE	COMMENTS
OFDA LAB	24.51	22.80	37.31	)) AVE CURVE = 35.58
OFDA INSHED	24.50	20.37	33.85	) Difference between LASER and OFDA) was 17.8 deg. SD(4.49) R SQ (0.278)
OFDA INSHED MID	24.73	19.57	32.92	INTERCEPT: CV(13.132) SE(5.295) X VARIABLE : CV(0.420) SE (0.099)
OFDA LAB MID	24.94	21.66	34.77	
LASER LAB	23.72	22.28	51.16	)) AVE CURVE =53.39
LASER INSHED	23.38	21.55	55.63	))

DATA
OFDA LAB GRID --- OFDA INSHED GRID

The variation is large. This may be likely due to the method of sampling by the operator of the testing machine (OFDA 2000). The operator stated that the sample used was 1 staple taken from the centre of the gross sample (refer methodology of testing procedures in appendix).
The mean magnitude of difference of 1.1657 was reflected with 5 of the samples being 3 microns greater in the OFDA Inshed measurement and 1 measurement being 6 microns different to that of the OFDA Lab.
Because of the larger variation the regression is at most, marginally different from 1 to 1.



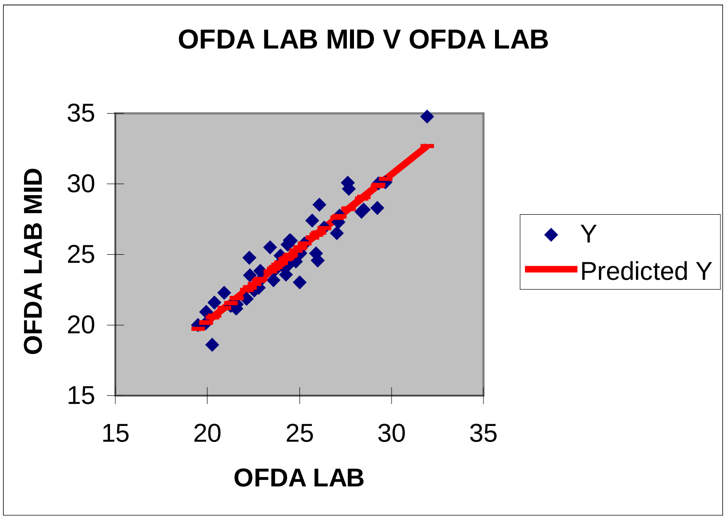
MEAN MAGNITUDE OF DIFFERENCE	**1.1657**

DISTRIBUTION OF THE DIFFERENCES

0-0.49	**0 MICRON DIFF**	**19**
0.5-1	**0.5 MICRON DIFF**	**10**
1-1.75	**1 MICRON DIFF**	**11**
1.76-2.75	**2 MICRON DIFF**	**4**
2.76-3.75	**3 MICRON DIFF**	**5**
3.76-4.75	**4 MICRON DIFF**	**0**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**1**

OFDA LAB GRID ---- OFDA LAB MID

There was a reasonable chance that the slope of 1 to 1 is consistent with the data.
There is a positive bias in the average of 3 times the standard error which is significant. This probably reflects a difference of mid sampling (Holt Stapleton 1992 – recommended midside position) and the grid sampling on a skirted fleece (unlike that in the 1992 Holt Stapleton work where the gridding was carried out on the saddle including the middle leg area).
The mean magnitude of difference being 0.8759 was reflected with the midside having only 1 sample being different by 3 microns to that of the lab result. The balance were all contained at a lower level.



MEAN MAGNITUDE OF DIFFERENCE **0.8759**

DISTRIBUTION OF THE DIFFERENCES

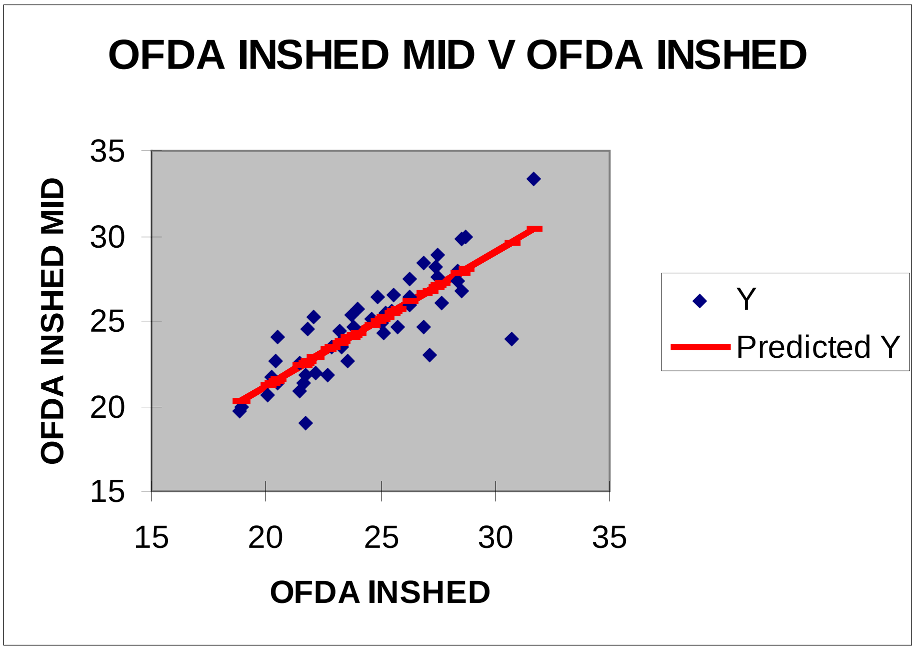
0- 0.49	**0 MICRON DIFF**	**22**
0.5-1	**0.5 MICRON DIFF**	**11**
1-1.75	**1 MICRON DIFF**	**9**
1.76-2.75	**2 MICRON DIFF**	**6**
2.76-3.75	**3 MICRON DIFF**	**1**
3.76-4.75	**4 MICRON DIFF**	**0**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**0**

OFDA INSHED GRID ---------- OFDA INSHED MID

There is a larger scatter reflected by the Standard Deviation. The mean difference is only marginally significantly different from the "0". There is a larger scatter reflected by the standard deviation and the mean magnitude of difference. The slope is significantly different from 1 to 1

There is a reasonable chance that there is a sampling error in 1 of these groups. Refer OFDA Lab – OFDA Inshed comparisons. The reason given for the difference in that comparison (OFDA Inshed) is probably applicable here, as the OFDA Inshed midsampling being a single site, the methodology of sample preparation would be considered adequate.

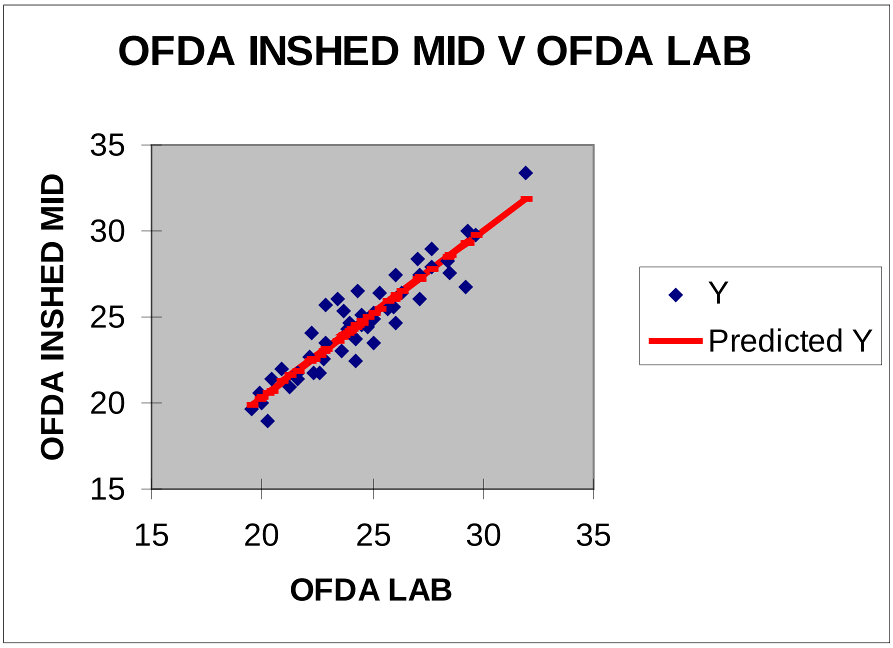
Mean magnitude of difference was 1.27 where there was 2 differences of 3 microns, 1 difference of 4 microns and 1 difference of 6 microns.



MEAN MAGNITUDE OF DIFFERENCE			**1.2653**
DISTRIBUTION OF THE DIFFERENCES			
	0- 0.49	**0 MICRON DIFF**	**11**
	0.5-1	**0.5 MICRON DIFF**	**15**
	1-1.75	**1 MICRON DIFF**	**15**
	1.76-2.75	**2 MICRON DIFF**	**5**
	2.76-3.75	**3 MICRON DIFF**	**2**
	3.76-4.75	**4 MICRON DIFF**	**1**
	4.76-5.75	**5 MICRON DIFF**	**0**
	5.76-6.75	**6 MICRON DIFF**	**1**

OFDA LAB GRID--------- OFDA INSHED MID

Mean magnitude of difference was 0.82 indicating lower sampling variation.
(The differences were all within 2 microns except for 1 measurement being 3 microns different.)
There is a slight significant bias to coarser inshed mid samples, which is consistent with the OFDA lab grid/OFDA mid comparison. The regression is close to 1 to 1 slope. This difference is again probably due to the position of the midside sampling



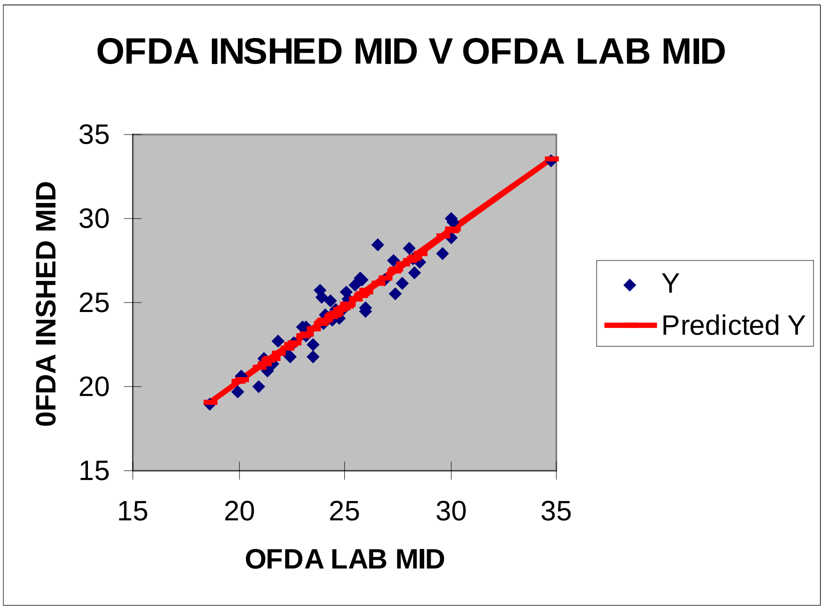
MEAN MAGNITUDE OF DIFFERENCE **0.8204**

DISTRIBUTION OF THE DIFFERENCES

0- 0.49	**0 MICRON DIFF**	**20**
0.5-1	**0.5 MICRON DIFF**	**12**
1-1.75	**1 MICRON DIFF**	**11**
1.76-2.75	**2 MICRON DIFF**	**5**
2.76-3.75	**3 MICRON DIFF**	**1**
3.76-4.75	**4 MICRON DIFF**	**0**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**0**

OFDA LAB MID ------- OFDA INSHED MID

The scatter is very tight with a mean magnitude of difference of 0.70. The slope is significantly less than 1 to 1 (around 10% lower). The OFDA inshed midside sample was slightly finer (0.21 microns). The results may indicate a difference in performance between individual machines used. Previous studies have indicated consistency between the OFDA 100 and the OFDA 2000. The differences were all contained within a 2-micron range with only 4 being 2 microns different. It is noticeable that there does not appear to be any problem with machine sampling procedures between these two tests, which go to support comments earlier regarding the OFDA inshed grid comparisons.



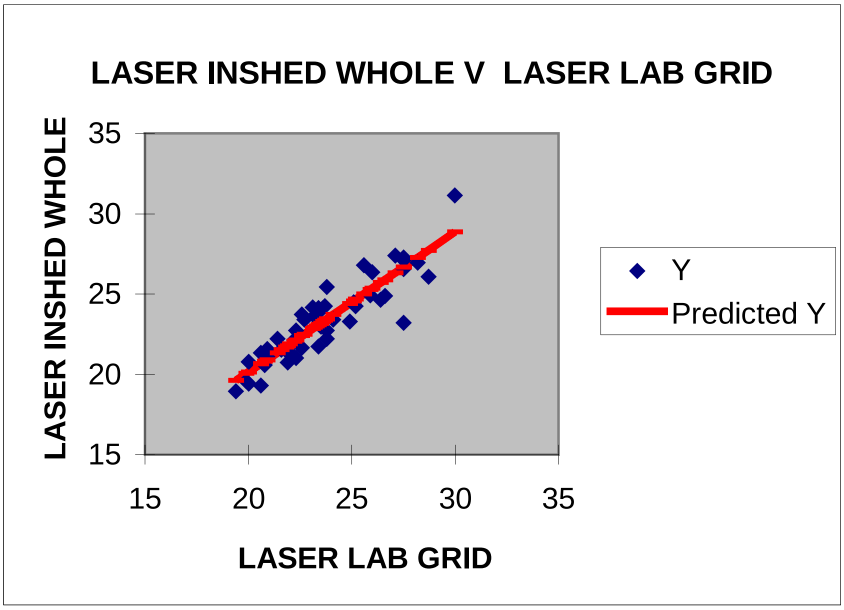
MEAN MAGNITUDE OF DIFFERENCE **0.7057**

DISTRIBUTION OF THE DIFFERENCES

0- 0.49	**0 MICRON DIFF**	**23**
0.5-1	**0.5 MICRON DIFF**	**12**
1-1.75	**1 MICRON DIFF**	**11**
1.76-2.75	**2 MICRON DIFF**	**4**
2.76-3.75	**3 MICRON DIFF**	**0**
3.76-4.75	**4 MICRON DIFF**	**0**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**0**

LASER LAB GRID--------- LASER INSHED WHOLE FLEECE

There was a reasonably low scatter. The inshed is biased significantly fine (0.34 microns) which is consistent with the regression slope of 0.87. No explanation is available for this.



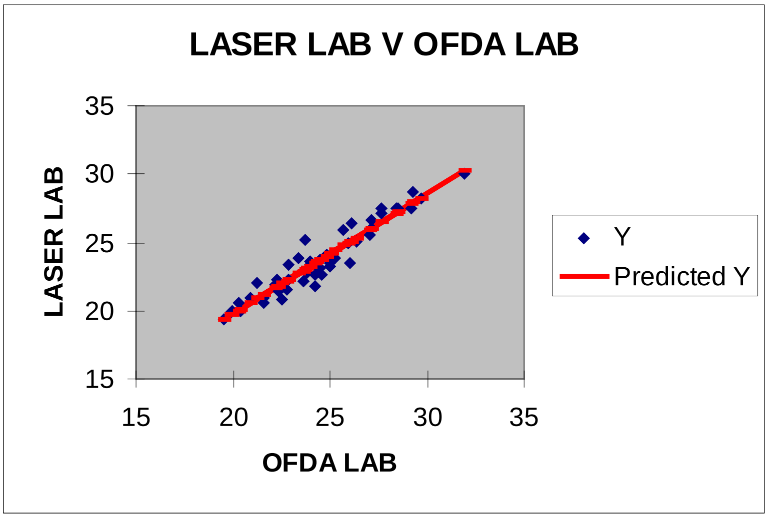
MEAN MAGNITUDE OF DIFFERENCE **0.9012**

DISTRIBUTION OF THE DIFFERENCES

0- 0.49	**0 MICRON DIFF**	**15**
0.5-1	**0.5 MICRON DIFF**	**17**
1-1.75	**1 MICRON DIFF**	**16**
1.76-2.75	**2 MICRON DIFF**	**1**
2.76-3.75	**3 MICRON DIFF**	**0**
3.76-4.75	**4 MICRON DIFF**	**1**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**0**

OFDA LAB GRID--------- LASER LAB GRID

The scatter was very tight with a mean magnitude of difference of 0.95
The laser gave a highly significant low bias of .79 microns in the mean difference. This is consistent with a regression slope of .88 which is significantly less than 1 to 1.
45 of the samples fell within the 1 micron difference range with the last 5 being only 2 microns difference.



MEAN MAGNITUDE OF DIFFERENCE **0.9522**

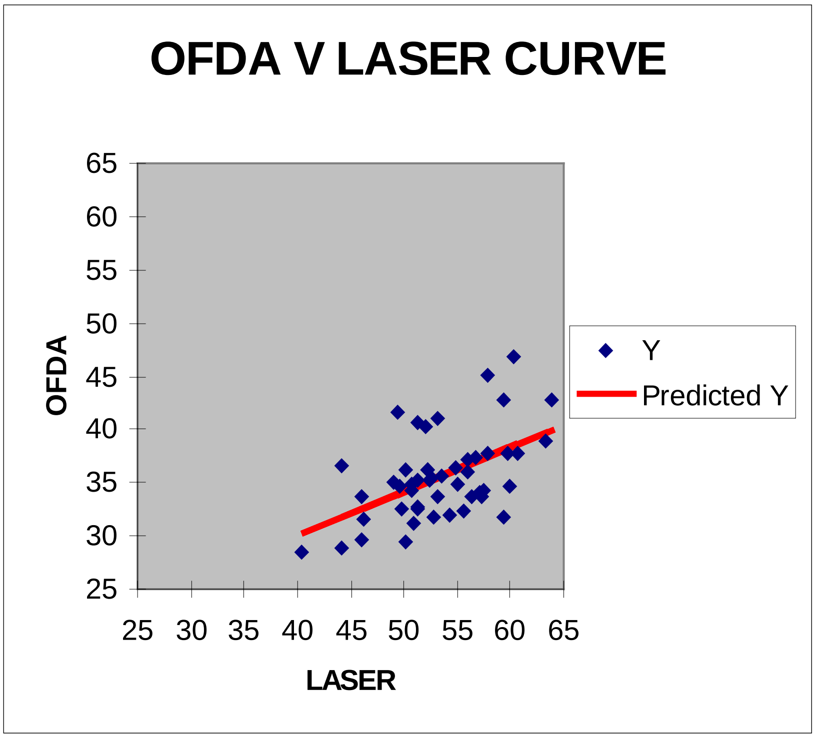
DISTRIBUTION OF THE DIFFERENCES

0- 0.49	**0 MICRON DIFF**	**14**
0.5-1	**0.5 MICRON DIFF**	**14**
1-1.75	**1 MICRON DIFF**	**17**
1.76-2.75	**2 MICRON DIFF**	**5**
2.76-3.75	**3 MICRON DIFF**	**0**
3.76-4.75	**4 MICRON DIFF**	**0**
4.76-5.75	**5 MICRON DIFF**	**0**
5.76-6.75	**6 MICRON DIFF**	**0**

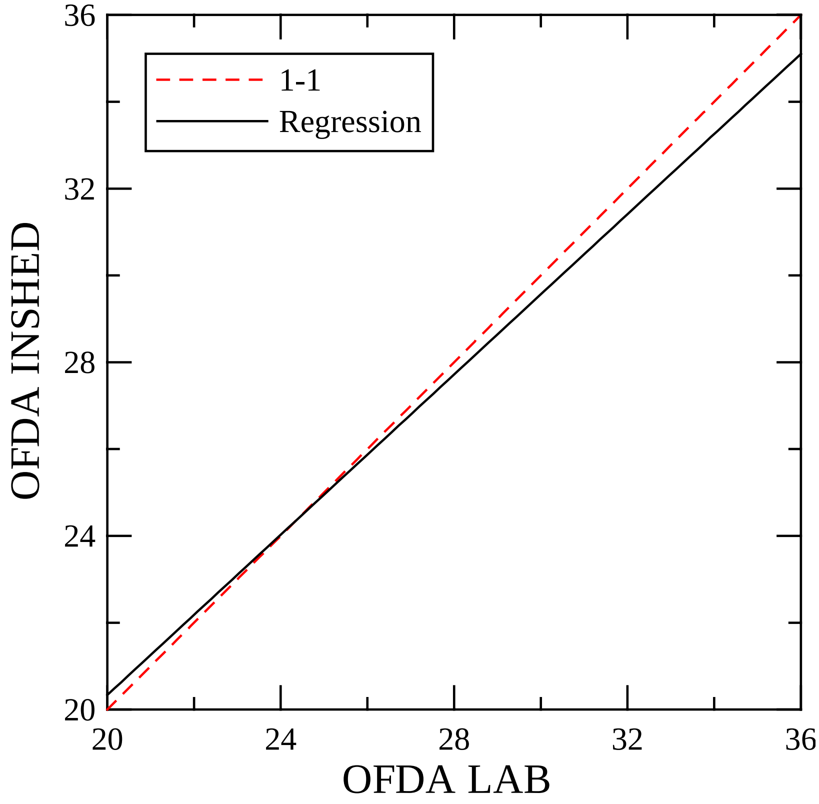
CURVE

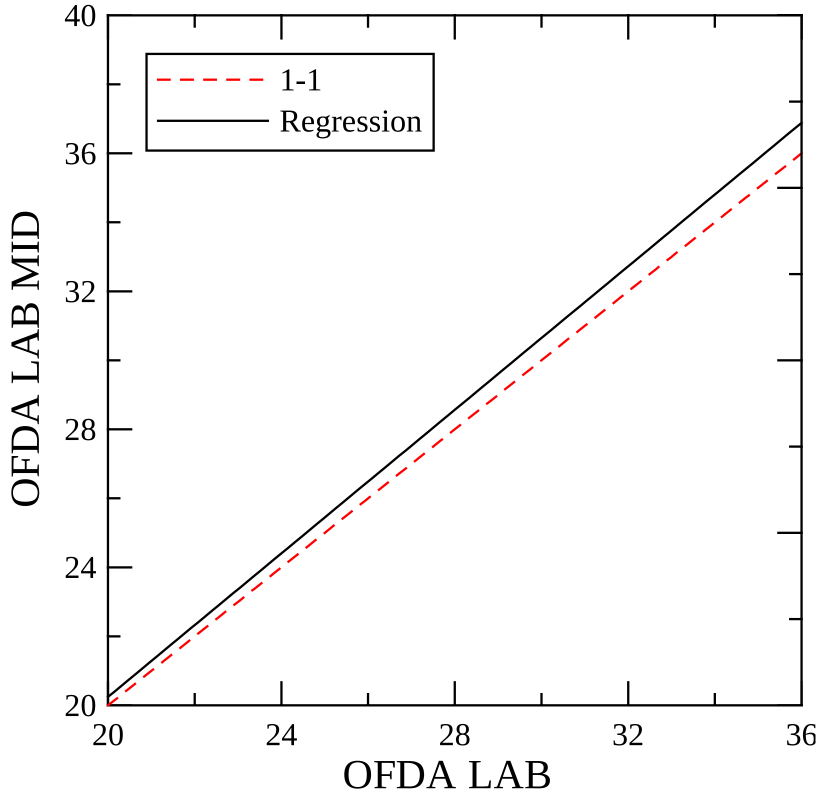
OFDA LAB, OFDA INSHED ------ LASER LAB, LASER INSHED

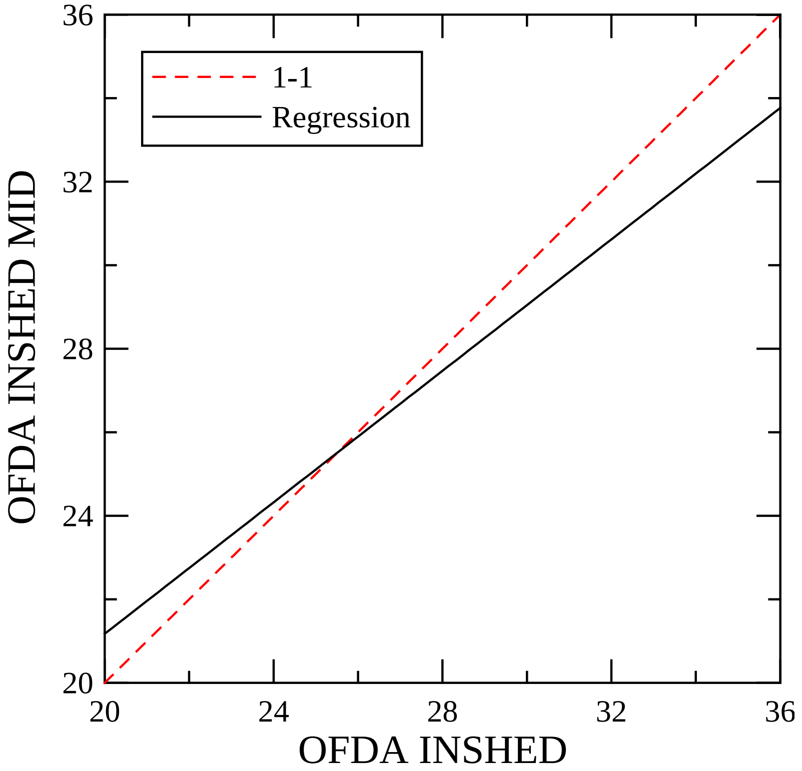
A large difference of 17.82 was evident with a standard error of 0.64.
The slope is 0.4, significantly different to 1.
The scatter is very large with the “R square” measurement of 0.278 being recorded.
There are large and significant differences on how these machines measure this characteristic.
The mean magnitude of difference of 17.82 and a standard deviation of 4.490 was recorded.

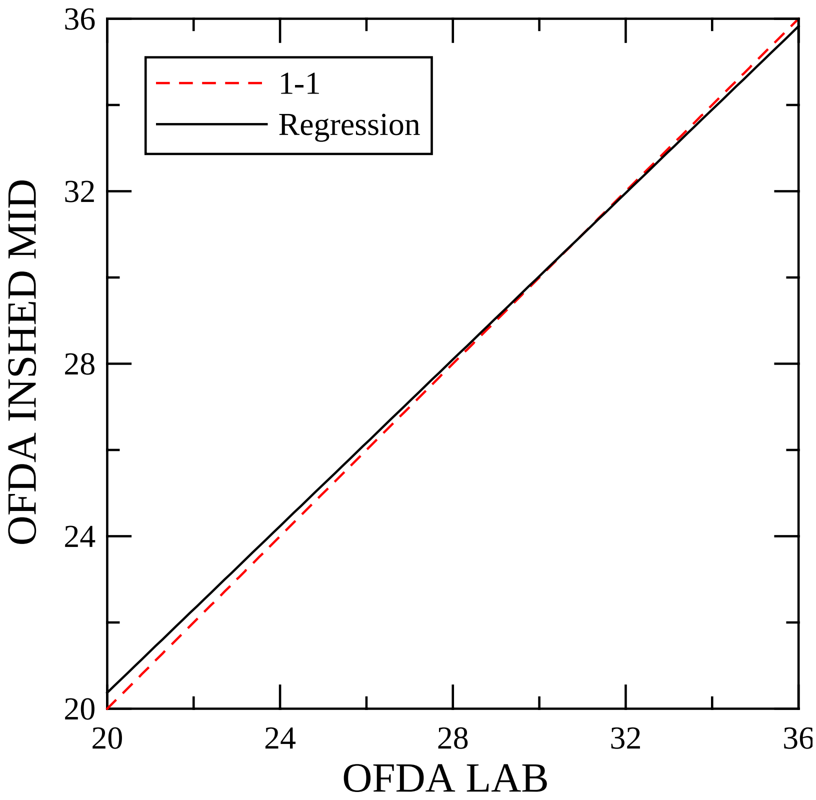


LASER AVERAGE	**53.39**
OFDA AVERAGE	**35.58**
MEAN MAGNITUDE OF DIFFERENCE & AVERAGE DIFFERENCE	**17.82**
SD	***4.49014***


1-1
Regression
OFDA INSHED
OFDA LAB
20
24
28
32
36


1-1
Regression
OFDA LAB MID
OFDA LAB
20
24
28
32
36
40


36
32
28
24
20
1-1
Regression
OFDA INSHED MID
20
24
28
32
36
OFDA INSHED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1-1
Regression
OFDA INSHED MID
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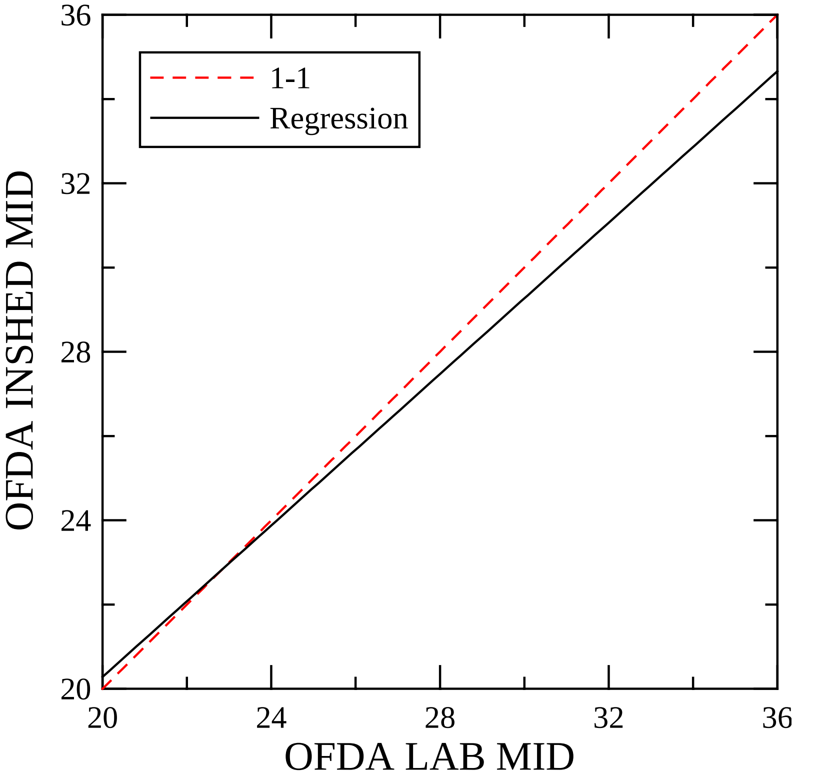
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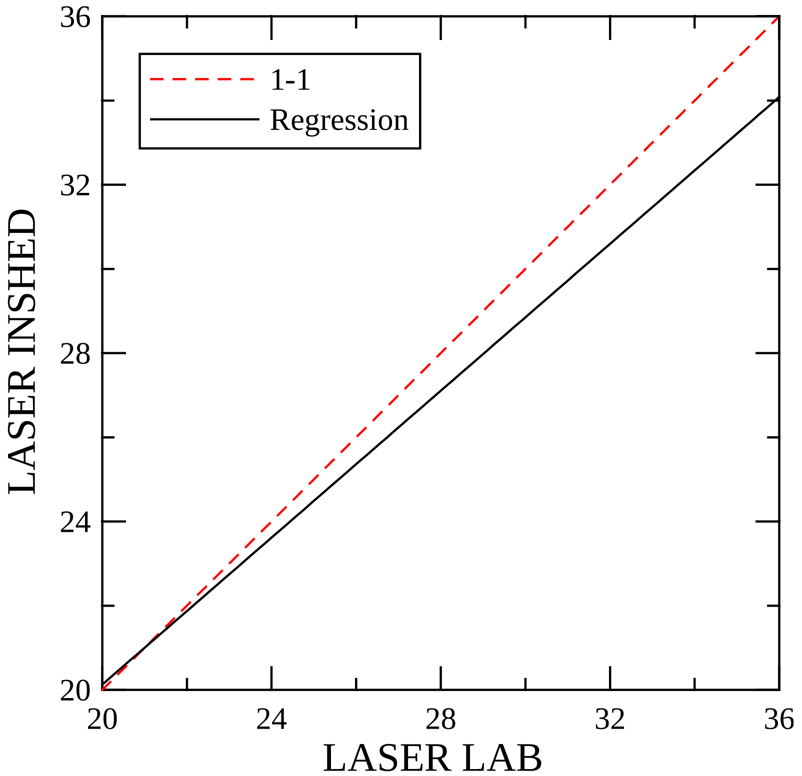
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1-1
Regression
LASER INSHED
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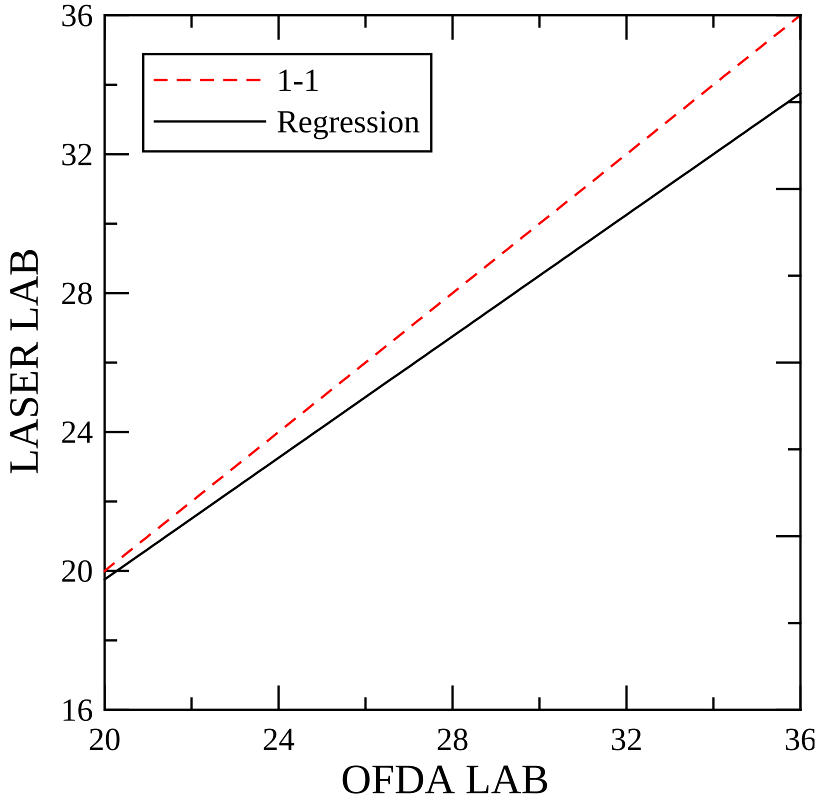
LASER LAB


1-1
Regression
LASER LAB
OFDA LAB
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