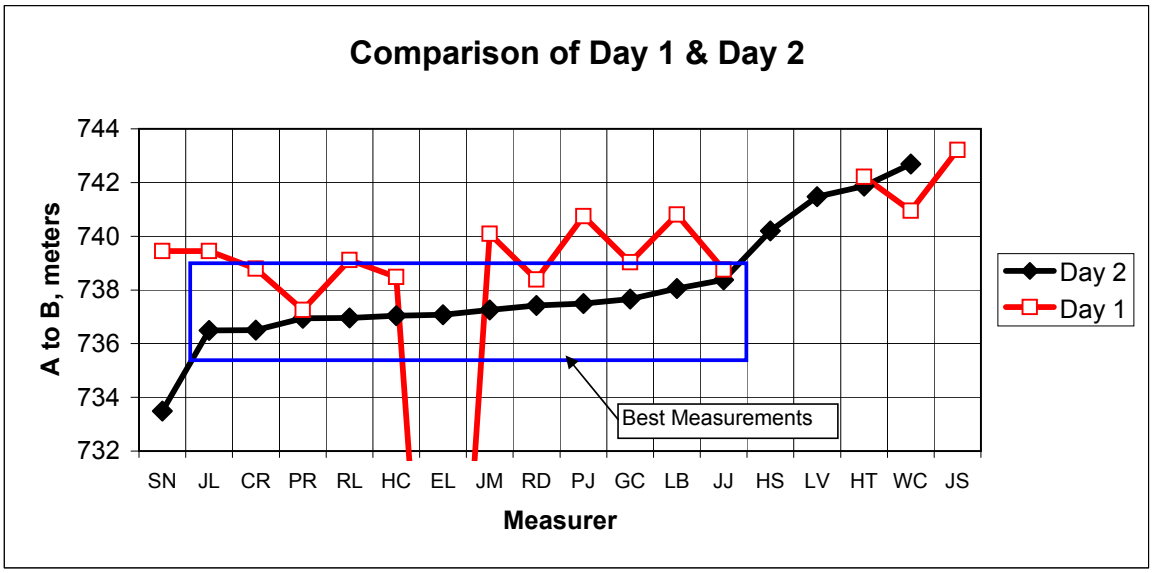
INTERNATIONAL ROAD COURSE MEASUREMENT SEMINAR

---- PUERTO RICO ----

Parque Julia de Burgos
Carolina (San Juan)
February 4 & 5, 2006

Standing from Left to Right: Heriberto Cosme, Renan Lopez de Azua, Pedro J. Davila, Hector Sanabria, Jose Llenin, Julio Juan Figueroa, Jose A. Melendez, Santos Negron, Rafael Diaz, Luis Berrios, Julio Soto, Eugenio Lopez and William Candelario.
Seated from Left to Right: Peter Riegel, Carlos Rodriguez, Linda Velez, Gerardo Cerra and Heriberto Torres.

RESULTS OF ALL MEASUREMENTS OF THE TEST COURSE - Measurement Results in Meters



Measurer	Ident	Meters Day 2	Meters Day 1	Contact Information
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Heriberto Torres Figueroa	HT	741.86	742.21	htorres1@choicecable.net
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IAAF INTERNATIONAL MEASUREMENT SEMINAR

* * * San Juan, Puerto Rico * * *

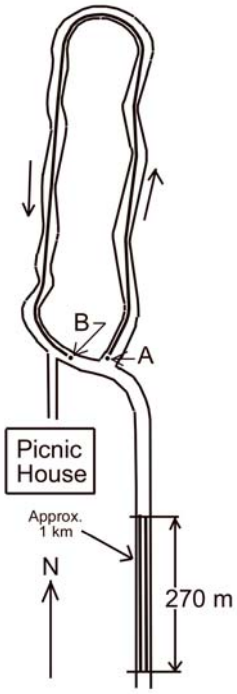
February 4 & 5, 2006

Organization of the Seminar

In 2005 I was contacted by Amadeo Francis, IAAF Vice President. He asked whether I was free to conduct a measurement seminar in February. I responded with an enthusiastic "yes." Amadeo put me in touch with Linda Velez, PLS, PE, President, *Instituto de Agrimensores del Colegio de Ingenieros y Agrimensores de Puerto Rico* (CIAPR), who was responsible for the general organization of the seminar. Linda contacted surveyors from all parts of Puerto Rico, and 17 came to the seminar.

The Venue

The seminar was held at the *Parque Julia de Burgos* in Carolina, a suburb of San Juan. The park contains about 1.7 km of bike paths, with a large picnic house conveniently located for use as a classroom. The test course was approximately 740 meters in length, with a 270 meter straight portion available nearby for the layout of a calibration course.



Preliminary Preparation

Before the seminar a general outline of the work and a statement of requirements was sent to Linda. When I arrived everything was ready. Each student had use of a bicycle and a Jones counter. I came to the venue the afternoon before the seminar to make decisions regarding how it could best be used.

Conduct of the Seminar

Day 1 – Saturday, February 4 – Everybody came to the picnic house, arriving from 8 to 9 AM. Jones counters were mounted to the bicycles. Breakfast was provided by CIAPR. I was introduced, made some preliminary remarks, and explained that we would first lay out a calibration course. Since all of the students were professional surveyors I did not feel it necessary to explain the use of the steel tape.

Nailing the end points of the calibration course

We left the classroom and went south on the bike path. I asked the students to lay out two parallel calibration courses on the path. I wanted to have parallel calibration courses so that we would have one-way traffic on each calibration course. I explained that in normal measurement a single calibration course was generally used. Only 270 meters was laid out because that was all that was available in a straight line. I explained that this length was suited to the venue and for instruction, but that 300 meters was the minimum acceptable for real-world measurements.

Once the calibration courses had been marked with a PK survey nail at each end, we returned to the classroom.

I explained that I would demonstrate the procedure of precalibration, measurement, and postcalibration, and then I would ask them to do the same thing. With students observing, I measured the distance between two points, A and B, on the bike path north of the classroom, and continued on from B to lay out a 1 km point. I explained to the students that each one should establish their own position of 1 km, and that later we would take a photograph of everybody standing on their mark. This gives people a good idea of how measurements can vary.

Taping the calibration course

Calibrating the bicycles

Measurers at their 1 km Marks

When I was finished with my measurement, the students assembled at the calibration course and began their measurement work. I went to the classroom and did my calculations. I posted my calculations and results on an easel so all could read them and see what I did.

Students took several hours measuring and calculating. Lunch was brought to the classroom at mid-day, and everybody enjoyed the meal.

As each measurer completed his work, he was asked to write his result on the easel. I had the shortest measurement, as I expected, and I explained how adherence to the *Shortest Possible Route* (SPR) was the way to get similar results. I collected all the data sheets for use in preparing this report.

During this time I was approached by Luis J. Barrios Montes. He explained that he could not balance on a bicycle, so he had one of the other students ride the bike while he did the calculations. He wondered whether this was acceptable. I explained that the bicycle riding was part of the measurement process. He asked whether it was all right for him to bring a tricycle the next day to use as a measurement bicycle. I said OK, bring it. I thought it was not as good as a bicycle, but with care it should enable him to get his own data.

Day 2 – Sunday, February 5 – We again met at the classroom. Breakfast was served. Luis had brought a brand-new tricycle, and it was admired by all the students. I explained that today would be easier, as now we all had experience. I said that today we would make multiple rides of distance A-B, and that each measurer could make as many rides as he wished, and use the best one as official. I explained that the

measurements would improve as the course became more familiar. I walked my bike along part of the course to demonstrate the SPR, explaining about 30 cm clearance from edges, and tangents between bends in the path.

Luis J. Berrios Montes with his tricycle

The mood this day was much less nervous than on Saturday. The measurers were more sure of themselves, and the measurement results showed a great improvement. The spirit of competitiveness was present, and people appeared to be taking pleasure in the exercise.

Luis' tricycle was also used by Linda Velez, who took time away from supervising the seminar to actually measure the route.

With measuring done, we went to the classroom and calculated results. Each measurer again posted results on the easel, and compared them with yesterday's results. All but two showed significant improvement of the first day's measurement, indicating that they had a better understanding of how to follow the *Shortest Possible Route*.

After lunch we enjoyed free-flowing discussions of various measurement topics, followed by a closing ceremony and presentation of certificates attesting that the participants had earned IAAF "C" level measurement status.

Discussion of Results

Results of the measurements are presented in this report. Included are:

1) List of measurers
2) Measurement results from day 1
3) Measurement results from day 2

On return home, I used the data provided by each measurer to correctly calculate the course length, using a computer. Sometimes the computer value does not agree with the length calculated by the measurer. In these cases, either the student or I made a mistake. Some common mistakes were:

- Loose riding – failure to follow the *Shortest Possible Route*
- Transposing numbers or incorrectly reporting
- Rounding off calibration figures prematurely
- Incorrect calculation of calibration figures
- Incorrect calculation of distances
- Incomplete data submitted to me at the seminar

Each student should study his numbers, and compare them with the computer calculations. Where there is a difference, checking will discover the reason.

What was the length of the course? – No one can say with certainty, but my estimate is about 737 meters. There is no clearly-defined way to calculate course length when many measurements exist. One method is to throw away the obvious outliers and use the median measurement of the rest. This is generally reliable. Other methods have been proposed, but ultimately some judgment must be used.

Most of the measurers had numbers in reasonable agreement with the above. The rest will improve with more practice. **In only one day we saw an enormous improvement – more riding practice will certainly improve each measurer's riding.**

The test course was almost entirely curved, with one 180 degree turn. As a result, measurements had more variation than would be the case if there had been more straight parts. The students did well to get their results.

All students have now learned the most important part of course measurement – the riding of a tight, correct line, following the *Shortest Possible Route*. All the calculation in the world cannot correct the results of a bad ride. The students are ready for more measurement work. And all are now officially proclaimed as IAAF Measurers, grade "C."

Upgrading from "C" to "B"

Students are encouraged to submit measurements for certification. Material should be submitted to Pedro Zapata, USATF Road Course Certifier, Puerto Rico (pzapata@ptmpr.com). If all is correct, he will issue a USA Track & Field Certificate of Accuracy for the course. After a student has successfully applied for and been granted 4 or 5 USATF certificates, I will recommend them for upgrading to "B" level.

A Personal Note

I had a wonderful time conducting this seminar. All of the students were enthusiastic and eager to learn, and many perceptive questions were asked. This is a good sign – an inquiring mind will learn quickly. The improvement between day 1 and day 2 was impressive. I was very happy to see it. I am confident that as the measurers work they will improve. In several cases, little improvement is possible, as results showed they are already well along.

All students are invited to correspond with me in Spanish. Although I cannot speak it well, I can understand the written word. I will answer all questions in English and Spanish.

My thanks to Linda Velez, without whose work this seminar would not have happened. I would have hated to miss it.

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IAAF "A" Measurer
IAAF Measurement Instructor
February 8, 2006

Copies of this report sent by email to:

All Seminar Participants
Pierre Weiss, IAAF
IAAF Measurement Administrators
Bernie Conway
Dave Cundy
Jean-Francois Delasalle
John Disley
Hugh Jones – AIMS Secretary
Pedro Zapata
Amadeo Francis
Gene Newman

PUERTO RICO MEASUREMENT SEMINAR - DAY 1 ACTIVITY - 4 FEBRUARY 2006

Parque Julia de Burgos - Carolina, PR

Calibration course = 270.00 metres

Participants rode the course, obtaining the following counter readings:

RAW MEASUREMENT COUNTS FOR ALL PARTICIPANTS - DATA SUBMITTED BY STUDENTS

Measurer	PJ	GC	WC	SN	JS	RL	HC	JJ	CR	HT	JL	LB	JM	HS	RD	EL	PR
Precal 1	3235.5	3225.5	3136	3154.5	3184	3218.5	3165.5	3158	3128.5	?	3124	3147.8	3152	3243	3229.5	3247	3204.5
Precal 2	3230	3225	3134	3155.5	3187	3218.5	3165	3158	3130.5	?	3124	3149.7	3150	3243.5	3227.5	3232	3202
Precal 3	3230.5	3222.5	3135	3154.5	3182.5	3218.5	3165	3156	3130	3130	3125	3148.5	3150	3235	3229	3223	3202.5
Precal 4	3231.5	3225	3132	3156.5	3183.5	3219.5	3166.5	3157	3127.5	3131	3124	3149	3151	3238	3232.75	3240	3203
Point A	94937.5	66825	94211	44387	58740	3134	32601	29600	39224	47101	126923	26080	17307	154016	97610	141708	59700
Point B	103807	75660.5	102818	53036.5	67509	11956	41264.5	38247	47790	55711	135491	34728.5	25951	162945	106452.8	150264	68451
1 km	106916.1	78779.5	105831.4	56084.79	70545.3	15056	44336.8	41305	108566	58764	138506	37752.5	no data	166023	109583.8	153683.4	71574
Postcal 1	3226.5	3224	3131	3153	3179	3217.5	3163	3157	3124	?	3125	3150.9	3151	no data	3231.5	3222	3200.5
Postcal 2	3225.5	3224.5	3131	3156	3179.5	3221	3161.5	3156	3124	?	3128	3148.6	3149.5	no data	3229.5	3237	3200.5
Postcal 3	3228.5	3226.5	3133	3154.5	3182.5	3220.5	3164	3158	3128.5	3128	3126	3149	3150.9	no data	3230	3222	3201
Postcal 4	3229.4	3225	3134	3156.5	3182	3222	3164	3157	3126.5	3127	3127	3148	3148.6	no data	3232	3233	3199
Student Calculated A-B, meters	740.64	739.79	740.68	739.47	742.52	739.99	738.49	738.28	738.29	741.53	739.71	740.83	no data	743.75	738.76	no data	737.25

RESULTS AS CALCULATED BY PETE RIEGEL FOR THIS REPORT. ABOVE DATA WAS USED IN THESE CALCULATIONS

Measurer	PJ	GC	WC	SN	JS	RL	HC	JJ	CR	HT	JL	LB	JM	HS	RD	EL	PR
Precal 4-ride average, counts	3231.875	3224.5	3134.25	3155.25	3184.25	3218.75	3165.5	3157.25	3129.125	3130.5	3124.25	3148.75	3150.75	3239.875	3229.688	3235.5	3203
Postcal 4-ride average, counts	3227.475	3225	3132.25	3155	3180.75	3220.25	3163.125	3157	3125.75	3127.5	3126.5	3149.125	3150		3230.75	3228.5	3200.25
Precal constant, counts per metre (includes 1.001)	11.98188	11.95454	11.61994	11.69780	11.80531	11.93322	11.73580	11.70521	11.60094	11.60604	11.58287	11.67370	11.68111	12.01154	11.97377	11.99532	11.87483
Postcal constant, counts per metre (Includes 1.001)	11.96556	11.95639	11.61253	11.69687	11.79234	11.93878	11.72699	11.70429	11.58843	11.59492	11.59121	11.67509	11.67833		11.97771	11.96936	11.86463
Day's constant (average) counts per metre	11.97372	11.95546	11.61623	11.69733	11.79882	11.93600	11.73140	11.70475	11.59468	11.60048	11.58704	11.67439	11.67972		11.97574	11.98234	11.86973
Precal 4-ride variation, counts	5.5	3	4	2	4.5	1	1.5	2	3	1	1	1.9	2	8.5	5.25	24	2.5
Postcal 4-ride variation, counts	3.9	2.5	3	3.5	3.5	4.5	2.5	2	4.5	1	3	2.9	2.4	0	2.5	15	2
A-B by computer, meters	740.75	739.03	740.95	739.44	743.21	739.11	738.49	738.76	738.79	742.21	739.45	740.81	740.09		738.39	714.05	737.25
A-B by Student, meters	740.64	739.79	740.68	739.47	742.52	739.99	738.49	738.28	738.29	741.53	739.71	740.83	no data	743.75	738.76	no data	737.25
Difference, meters	0.11	-0.76	0.27	-0.03	0.69	-0.88	0.00	0.48	0.50	0.68	-0.26	-0.02			-0.37		0.00

Bicycle check of calibration course by Pete - How many 30 m tape lengths were used? Some thought 8, some thought 9

begin 30 m 56950

end 30 m 57306 356 counts for 30 m

From Pete's precalibration rides: 3203 counts for unknown length 3203/356 = 8.997191 or, 9 tape lengths!

PUERTO RICO MEASUREMENT SEMINAR - DAY 2 ACTIVITY - 5 FEBRUARY 2006

Parque Julia de Burgos - Carolina, PR

Calibration course = 270.00 metres

Participants rode the course, obtaining the following counter readings:

RAW MEASUREMENT COUNTS FOR ALL PARTICIPANTS - DATA SUBMITTED BY STUDENTS

Measurer	PJ	GC	WC	SN	JS	RL	HC	JJ	CR	HT	JL	Tricycle LB	JM	HS	RD	EL	PR	Tricycle LV
Precal 1	3237.5	3224.5	3132	3158	3183	3218	3144.5	3155	3129.5	3132.5	3129	3440	3149	3236.5	3235.8	3236	3203.5	3439
Precal 2	3238	3224.5	3135	3157	3183.5	3222	3142.5	3156.5	3129	3133	3128	3443	3150	3239.5	3232.7	3233	3205	3439.5
Precal 3	3238.4	3229	3134	3158	3183.5	3220	3144.5	3154.5	3129.5	3136	3128	3439	3150	3243	3232	3232	3204	3437.5
Precal 4	3235	3225	3134	3157	3183.5	3222.5	3144	3157.5	3128	3130	3129	3438	3152.6	3240	3233.3	3234	3203	3437
Point A-B (1)	8860	8824.5	8645	8587.5	8766	8803	8600	8642	8545.5	8629	8555	9409.6	8617	8889.5	8847.8	8835	8754.5	9517
Point A-B (2)	8852.9	8822	8625.5	8642.5			8599	8644.5	8548	8629	8546	9407.3	8611.5	8893	8849.2	8839	8752	9502
Point A-B (3)	8843.6	8823	8641	8643.5			8596.5	8646	8543.5	8641	8541	9408.6	8609.5	8889	8843.8	8844		9451.5
Point A-B (4)	8857.5	8825.5	8632	8642			8591	8638.5	8548	8613	8543	9405.5	8611	8902	8842.5	8834		9512
Point A-B (5)										8621.5								
Postcal 1	3230.9	3224	3130.5	3158.5	no data	3222	3144.5	3155	3135	3124	3125	3433.5	3149.5	3237.5	3234.5	3229	3203	3437.5
Postcal 2	3233	3227	3133.5	3158.5	no data	3225	3142.5	3156.5	3126	3133	3134	3435	3151	3242	3234.5	3231	3203	3439.5
Postcal 3	3230	3226	3130.5	3157.5	no data	3223	3146	3154	3126	3131.5	3126	3434.5	3148	3236	3234.5	3233	3202.5	3438
Postcal 4	3233	3226.5	3131.5	3159	no data	3223	3143.5	3156.5	3128	3132.5	3125	3436	3148.5	3239.1	3237.5	3234	3202.5	3438
Student Calculated A-B, meters	737.49	737.69	742.67	738.14	742.75	737.5	736.98	no data	736.52	741.85	736.5	738.03	737.29	740.19	737.44	737.82	736.95	741.42

RESULTS AS CALCULATED BY PETE RIEGEL FOR THIS REPORT. ABOVE DATA WAS USED IN THESE CALCULATIONS

Measurer	PJ	GC	WC	SN	JS	RL	HC	JJ	CR	HT	JL	LB	JM	HS	RD	EL	PR	LV
Precal 4-ride average, counts	3237.225	3225.75	3133.75	3157.5	3183.375	3220.625	3143.875	3155.875	3129	3132.875	3128.5	3440	3150.4	3239.75	3233.45	3233.75	3203.875	3438.25
Postcal 4-ride average, counts	3231.725	3225.875	3131.5	3158.375		3223.25	3144.125	3155.5	3128.75	3130.25	3127.5	3434.75	3149.25	3238.65	3235.25	3231.75	3202.75	3438.25
Precal constant, counts per meter (includes 1.001)	12.00171	11.95917	11.61809	11.70614	11.80207	11.94017	11.65563	11.70011	11.60048	11.61484	11.59862	12.75348	11.67982	12.01107	11.98772	11.98883	11.87807	12.74699
Postcal constant, counts per meter (includes 1.001)	11.98132	11.95963	11.60975	11.70938		11.94990	11.65655	11.69872	11.59955	11.60511	11.59492	12.73402	11.67555	12.00700	11.99439	11.98141	11.87390	12.74699
Day's constant (average) counts per metre	11.99152	11.95940	11.61392	11.70776		11.94503	11.65609	11.69942	11.60001	11.60998	11.59677	12.74375	11.67768	12.00903	11.99105	11.98512	11.87598	12.74699
Precal 4-ride variation, counts	3.4	4.5	3	1	0.5	4.5	2	3	1.5	6	1	5	3.6	6.5	3.8	4	2	2.5
Postcal 4-ride variation, counts	3	3	3	1.5		3	3.5	2.5	9	9	9	2.5	3	6	3	5	0.5	2
Calculated values of A-B	738.86	737.87	744.37	733.49		736.96	737.81	738.67	736.68	743.24	737.71	738.37	737.90	740.23	737.87	737.16	737.16	746.61
	738.26	737.66	742.69	738.19			737.73	738.88	736.90	743.24	736.93	738.19	737.43	740.53	737.98	737.50	736.95	745.43
	737.49	737.75	744.02	738.27			737.51	739.01	736.51	744.27	736.50	738.29	737.26	740.19	737.53	737.91		741.47
	738.65	737.96	743.25	738.14			737.04	738.37	736.90	741.86	736.67	738.05	737.39	741.28	737.42	737.08		746.22
										742.59								

Best measurement A-B, meters	737.49	737.66	742.69	733.49		736.96	737.04	738.37	736.51	741.86	736.50	738.05	737.26	740.19	737.42	737.08	736.95	741.47
Best as calculated by student, meters	737.49	737.69	742.67	738.14		737.5	736.98		736.52	741.85	736.5	738.03	737.29	740.19	737.44	737.82	736.95	741.42
Difference	0.00	-0.03	0.02	-4.65		-0.54	0.06		-0.01	0.01	0.00	0.02	-0.03	0.00	-0.02	-0.74	0.00	0.05