Test of the TOMI device – 04.11.2007

Technology: WebCAM at 30 fps / VGA resolution. Sensor with 4 LED emitter sensors. Software with picture analysis.

Functionality: The 4 LED signals are received by a Web Cam standing at a distance of about 1 meter. The result is a simple VGA picture containing only the 4 LEDs as dots. It is quite clear that already the pixel resolution of the webcam at a distance of about 1 meter is critical. The sampling frequency of 30 Hz means a data point each 30 milliseconds. At a speed of 1.6 m/s around impact the distance between the measured data points is about 58 mm! With a data signal which is not precise as a video signal no reasonable interpolation is possible.

The next problem is the two dimensional picture. This is only providing information on two translational axis (up/down and left/right) and one rotational axis (in the side axis). All the information on other translations and rotations is only calculated from the geometrical form identified on the screen.

Analysis:
The calibration is complicated and it is unclear what exactly is calibrated. It seems that the path direction is calibrated by the direction of the receiver unit. As this unit is placed "parallel" to the target line all errors in placing the receiver unit are affecting path direction. Additionally the mounting of the sensor clip seem to affect the data.

The data of the TOMI is generally affected by significant errors. However the data for face at impact, path direction, impact spot, shaft angle and timings is generally extremely faulty and often displays even completely wrong data values. Especially path and spot are extremely affected by face rotation. Both face rotation and lateral distance to the receiver unit must be identified by change of the distance of the two side sensors. Often face angle and path angle seem to be interchanged. Aim and rotation seem to be somehow more accurate.

This can only be explained by mis-interpretations of the stroke. As the two dimensional picture does not contain enough information to really measure a putting stroke, the software needs to simulate the stroke and then to decide which conclusion is more likely. I.e. if aiming offcenter the data seems dramatically wrong. Also if delofting the face the path is showing extremely wrong data.

Conclusions:

- There is a general problem with the technology, not precise, frequency too low, only a two dimensional picture available.

- TOMI data is generally affected with significant noise and unpredictable errors.

- Especially path, shaft, spot, speed and timing are often not related to true data.

- For 5 consistent putting strokes the results seem better, but always with random noise

- Assumption - Tomi might take the first putt as a reference to show some reasonable data. The other putts are then tuned / faked in comparison to the first one.

- For inconsistent putting the data falls apart. Especially for a home model this is critical. Sometimes it is hard to believe that you look at the same data sample. Data seems random.

- Putting with delofting or with offcenter aiming results in random results.

- Aiming is in most cases accurate in a range of about +-1 degree, but sometimes also off.

- Rotation is in most cases accurate in a range of +- 2 degrees, but sometimes also off.

- For amateurs TOMI might show some rough average tendencies.

- However it is not distinguishable what is data and what is error.

- The unpredictable extreme errors are completely confusing if repeating measurements.

- There is no reliable information on consistency (the most important aspect for good players).

- For better players TOMI might be even dangerous in showing wrong data, especially in face, path and spot.

- For skilled players the resolution of TOMI is also too low to show any relevant data.

Statistical comparison of a data set

	Mean error	Abs error	Biggest error	% Error	% biggest error
Face address	1,36 °	1,48 °	5,5 °		
Face impact	0,24 °	4,24 °	5,9 °		
Path impact	1,0 °	1,56 °	4,2 °		
Rot backswing	1,06 °	3,2 °	5,67 °		
Rot forward	1,39 °	4,46 °	8,7 °		
Rot total	1,85	4,92	9,6 °		
Shaft angle	-0,4 °	2,98 °	4,71 °		
Impact spot	-19,2 mm	24,4 mm	38 mm		
Backswing time	-62,4 ms	62,4 ms	-128 ms	8,8 %	19%
Forward time	24,8 ms	38,8 ms	47 ms	10,4 %	11 %
Stroke rhythm	-0,34	0,35	0,58	18,2 %	31,8 %
Speed	6,8 mm/s	77,2 mm/s	-176 mm/s	7,90 %	17,3%

Files for face, path and rotation values:

"Same path diff face"

Files for shaft values

"diff lofts"

Files for spot values:

"aim offcenter"
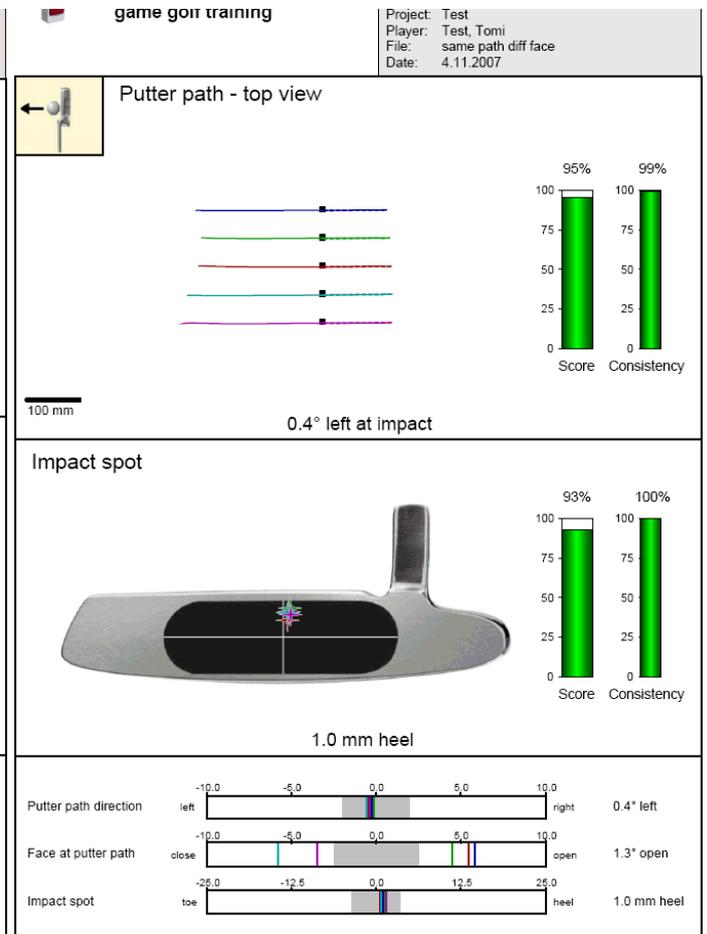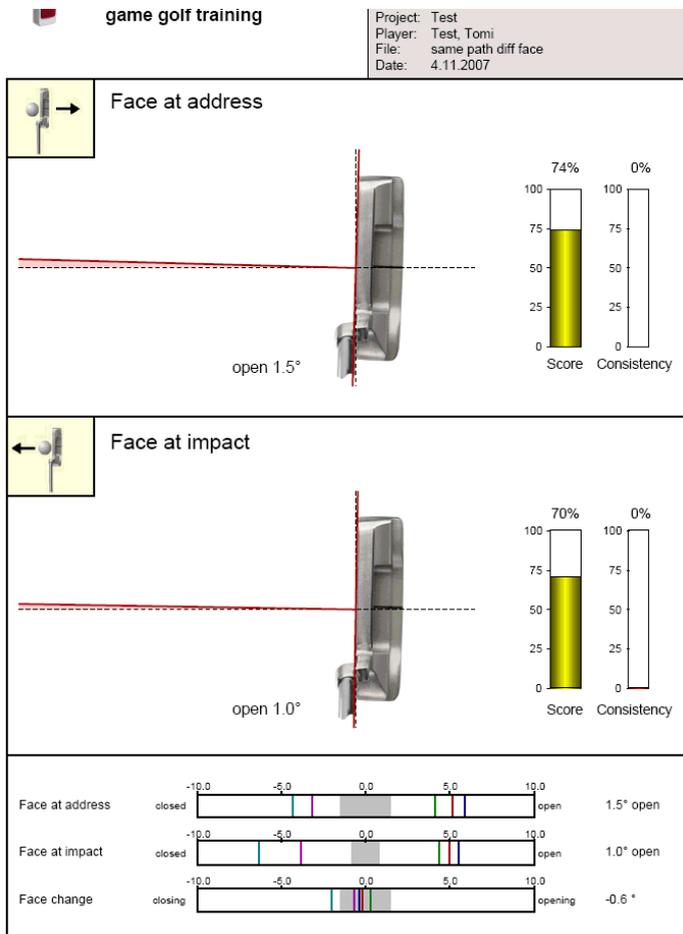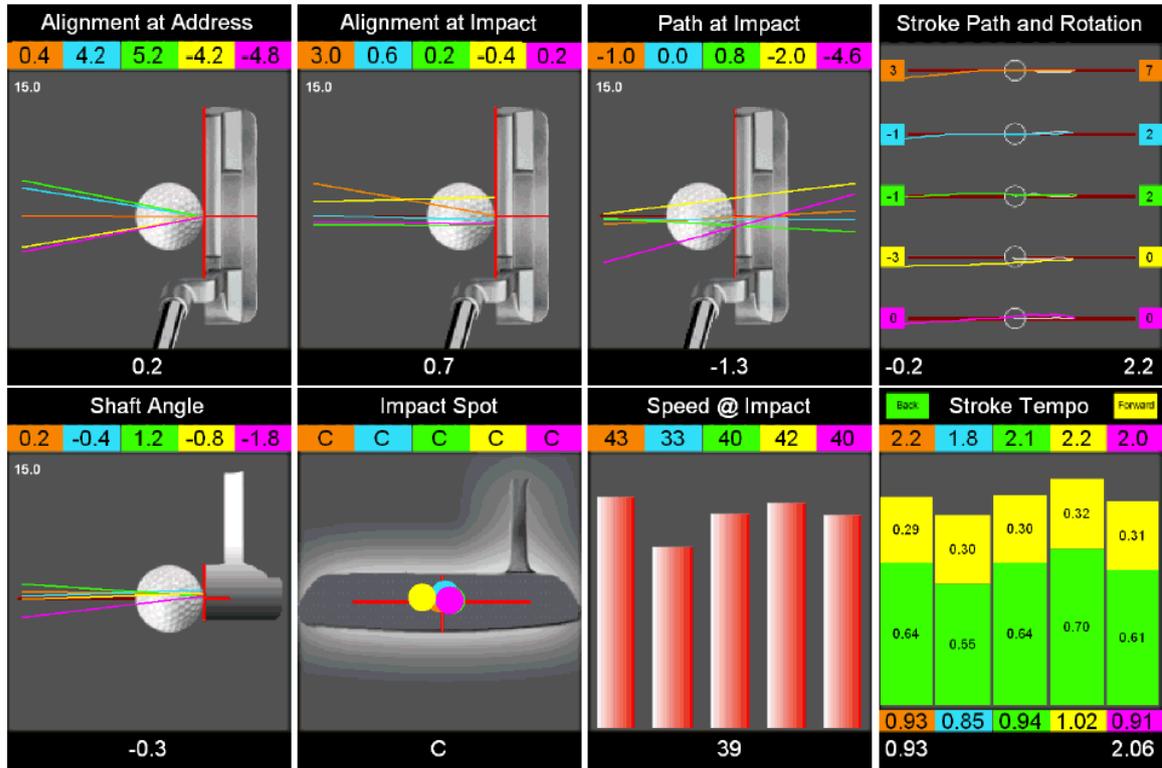
Files for times and speed:

" speed"

Comparison of constant path and inconsistent face (first 3 open and last 2 closed).
Tomi data for Alignment at Impact and Path at impact is completely wrong.

Stroke Report

Name: Test
Date: 11/4/2007 19:51:28
Title: same path diff face

Alignment at Address				
0.4	4.2	5.2	-4.2	-4.8

15.0

0.2

Alignment at Impact				
3.0	0.6	0.2	-0.4	0.2

15.0

0.7

Path at Impact				
-1.0	0.0	0.8	-2.0	-4.6

15.0

-1.3

Stroke Path and Rotation

-0.2   2.2

Shaft Angle				
0.2	-0.4	1.2	-0.8	-1.8

15.0

-0.3

Impact Spot				
C	C	C	C	C

C

Speed @ Impact				
43	33	40	42	40

39

Stroke Tempo

Back				Forward
2.2	1.8	2.1	2.2	2.0

0.29	0.30	0.30	0.32	0.31
0.64	0.55	0.64	0.70	0.61
0.93	0.85	0.94	1.02	0.91

0.93   2.06

game golf training

Project: Test
Player: Test, Tomi
File: same path diff face
Date: 4.11.2007

Face at address

open 1.5°

74%   0%

Score   Consistency

Face at impact

open 1.0°

70%   0%

Score   Consistency

Face at address	closed	open	1.5° open
Face at impact	closed	open	1.0° open
Face change	closing	opening	-0.6 °

game golf training

Project: Test
Player: Test, Tomi
File: same path diff face
Date: 4.11.2007

Putter path - top view

100 mm

95%   99%

Score   Consistency

0.4° left at impact

Impact spot

93%   100%

Score   Consistency

1.0 mm heel

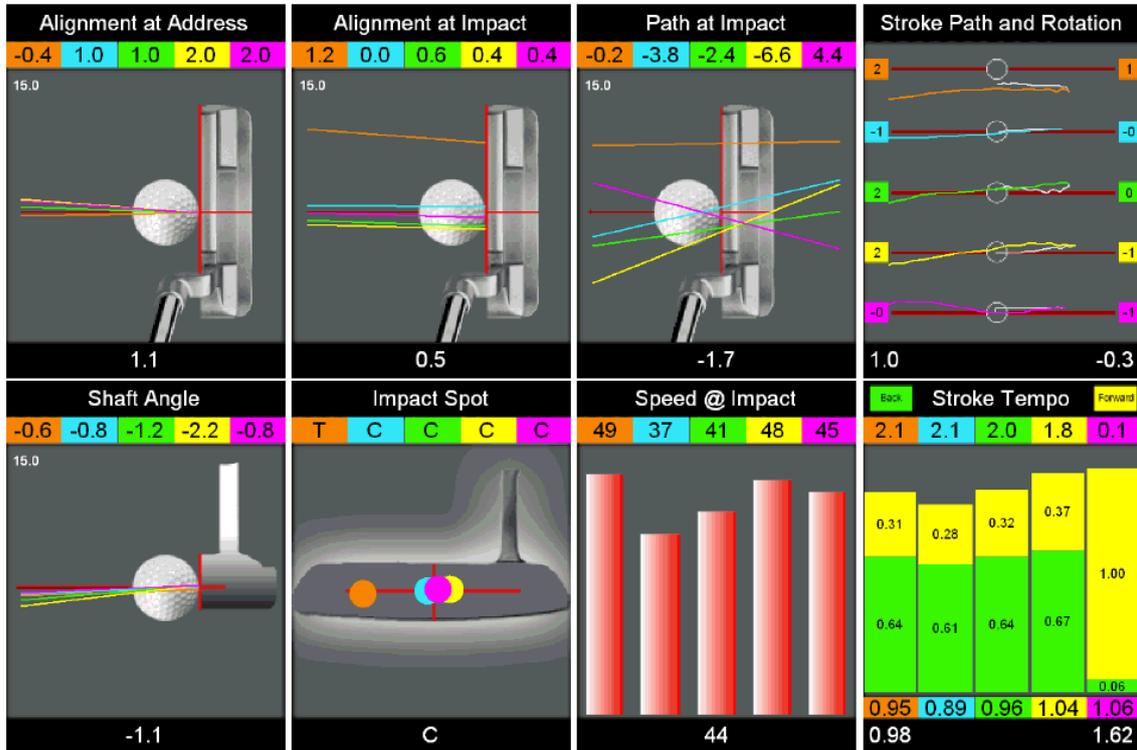|			
Putter path direction	left	right	0.4° left
Face at putter path	close	open	1.3° open
Impact spot	toe	heel	1.0 mm heel

Comparison of constant path and offcenter aiming (first 4 toe and last 1 heel).
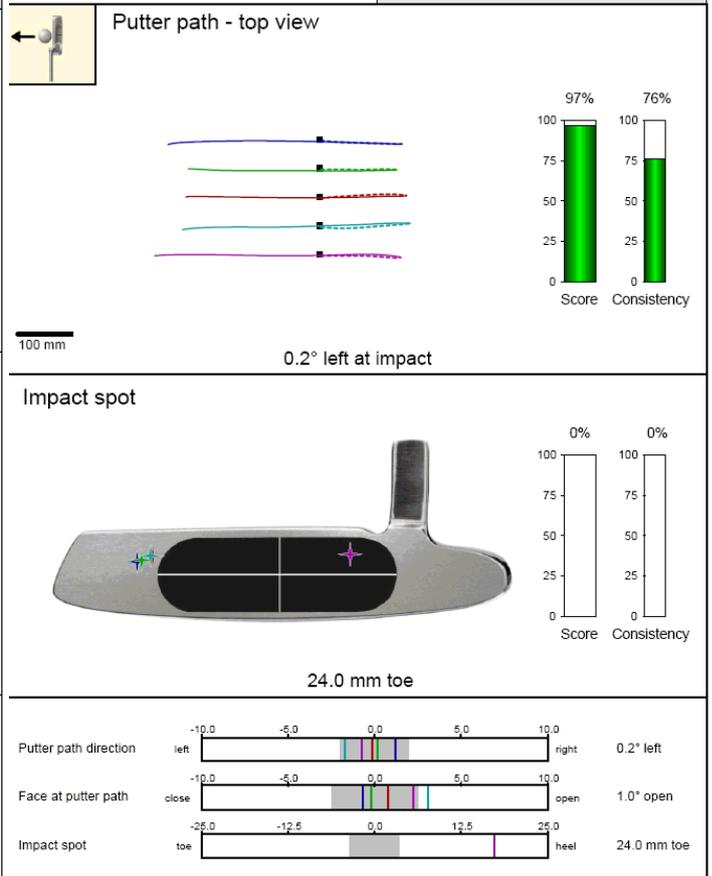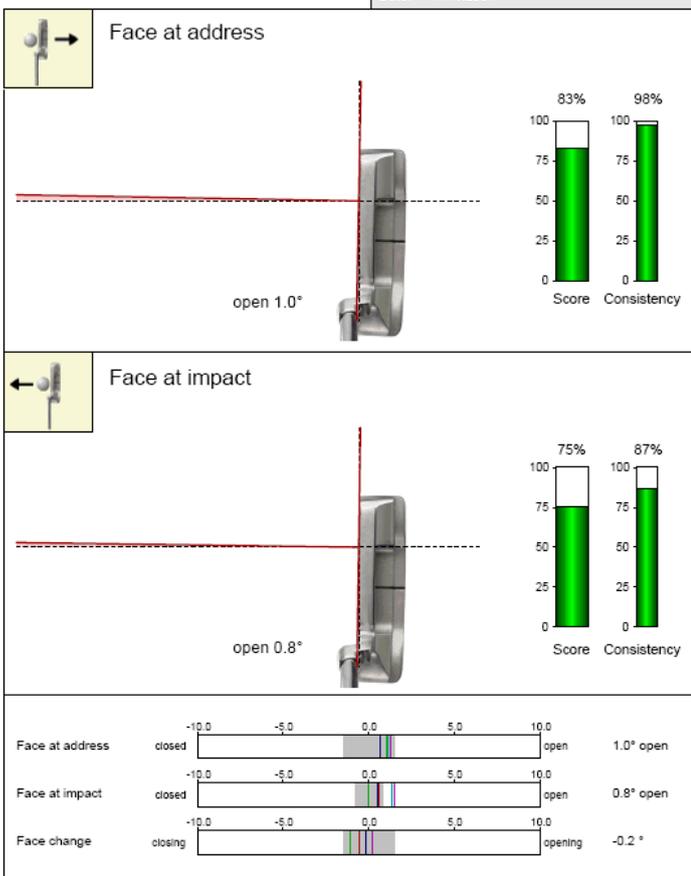Tomi data for Path at impact and Impact Spot is completely wrong. TOMI shows 4 putts centered.
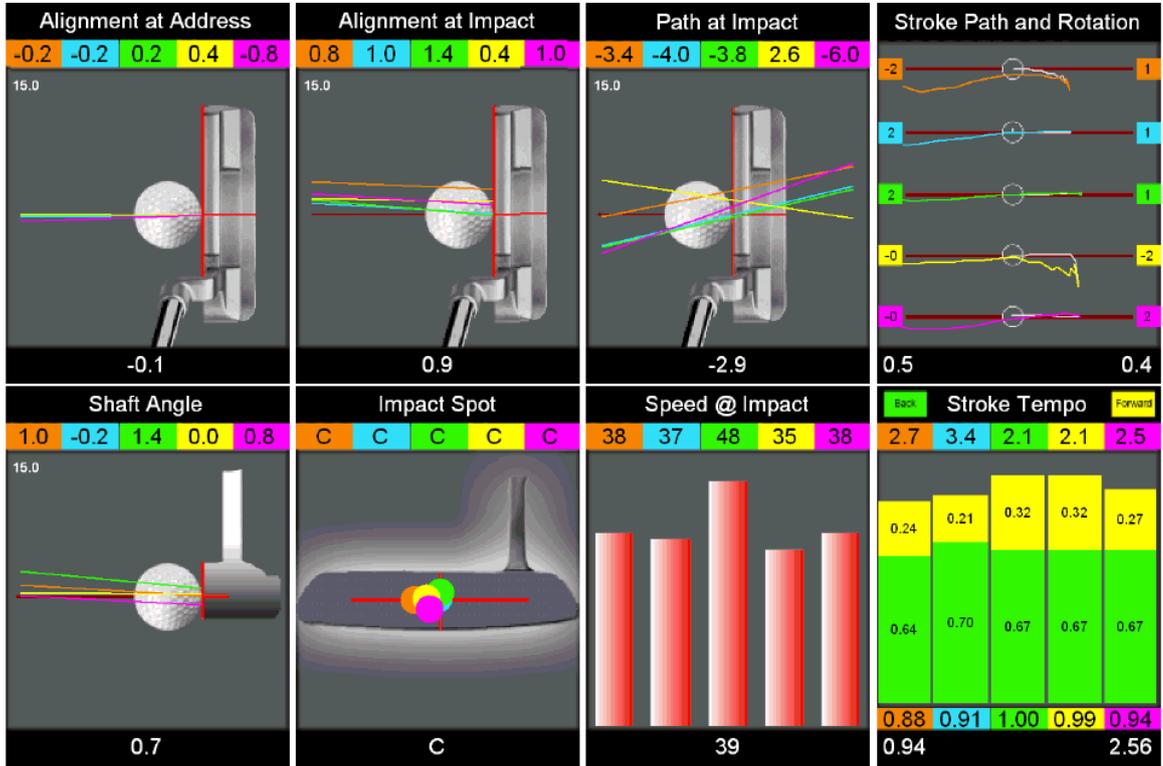
Comparison of constant path and different loft (first neutral, 2 add loft, 2 deloft).
Tomi data for Shaft angle is completely wrong. Instead the perfect path is incredibly wrong.
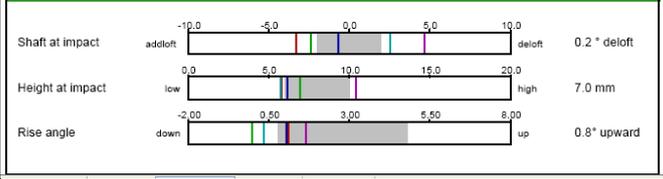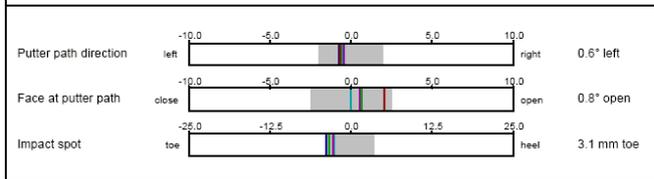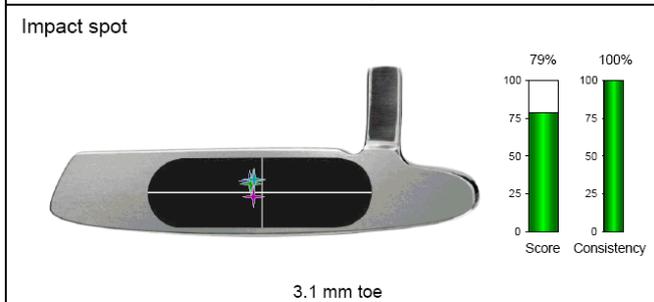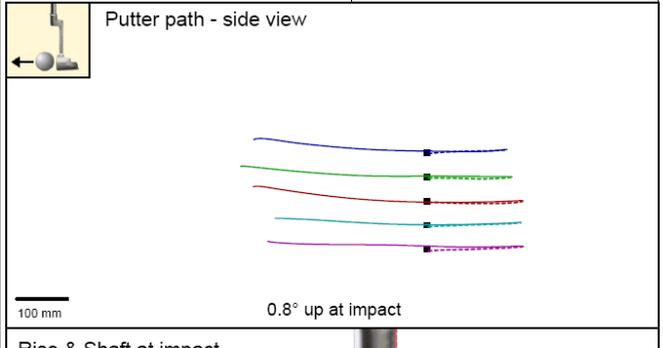Look at the TOMI stroke path at the top right.

Tomi™ — Stroke Report

Name: Test
Date: 11/4/2007 22:34:38
Title: diff lofts

Alignment at Address
-0.2 -0.2 0.2 0.4 -0.8
15.0
-0.1

Alignment at Impact
0.8 1.0 1.4 0.4 1.0
15.0
0.9

Path at Impact
-3.4 -4.0 -3.8 2.6 -6.0
15.0
-2.9

Stroke Path and Rotation
-2 ... 1
2 ... 1
2 ... 1
-0 ... -2
-0 ... 2
0.5   0.4

Shaft Angle
1.0 -0.2 1.4 0.0 0.8
15.0
0.7

Impact Spot
C C C C C
C

Speed @ Impact
38 37 48 35 38
39

Stroke Tempo (Back / Forward)
2.7 3.4 2.1 2.1 2.5
0.24 0.21 0.32 0.32 0.27
0.64 0.70 0.67 0.67 0.67
0.88 0.91 1.00 0.99 0.94
0.94   2.56

game golf training

Project: Test
Player: Test, Tomi
File: diff lofts
Date: 4.11.2007

Putter path - top view

93%   100%

0.6° left at impact

Impact spot

79%   100%

3.1 mm toe

	-10.0	-5.0	0,0	5,0	10.0		
Putter path direction	left				right	0.6° left
Face at putter path	close				open	0.8° open
Impact spot	-25.0 / toe	-12.5	0,0	12.5	25.0 / heel	3.1 mm toe

game golf training

Project: Test
Player: Test, Tomi
File: diff lofts
Date: 4.11.2007

Putter path - side view

0.8° up at impact

Rise & Shaft at impact

Shaft angle: 0.2° deloft

Rise angle: 0.8° up

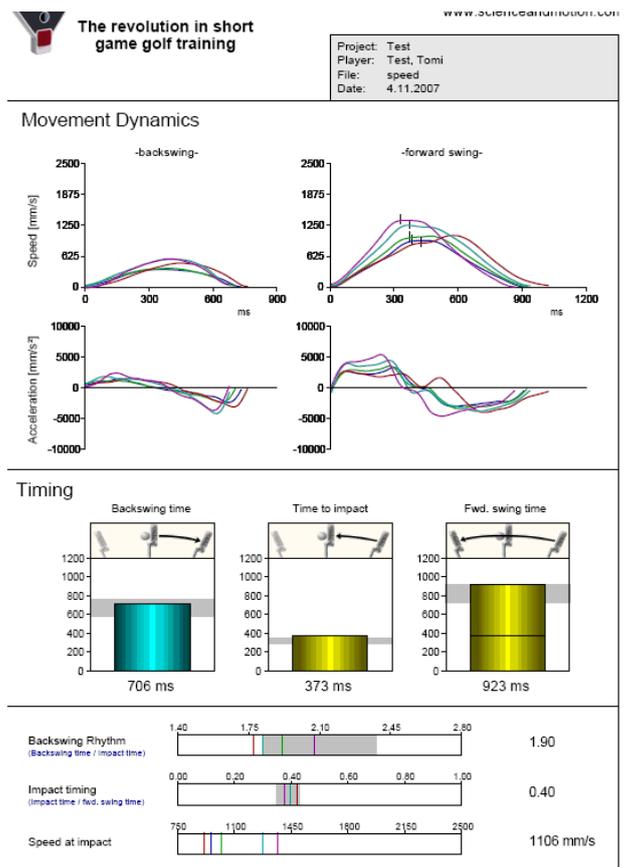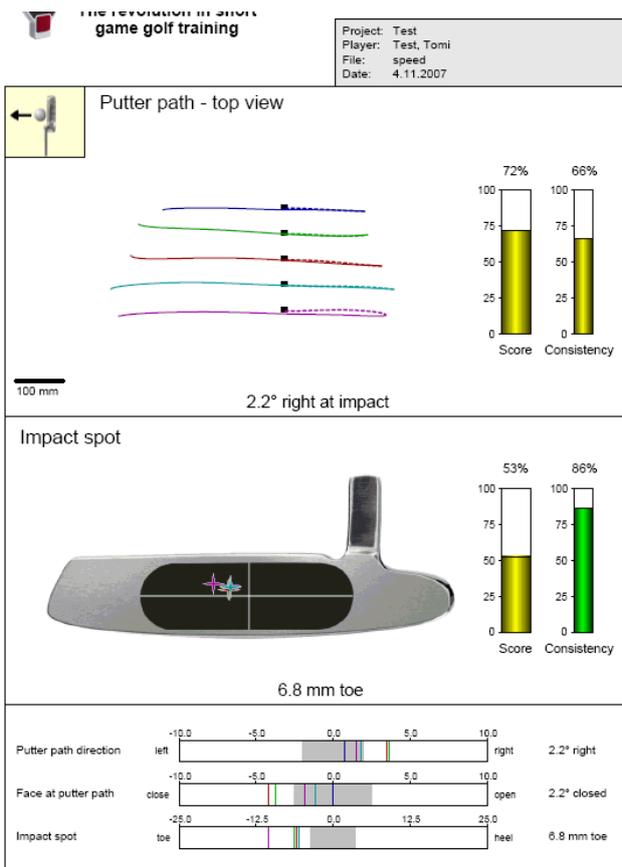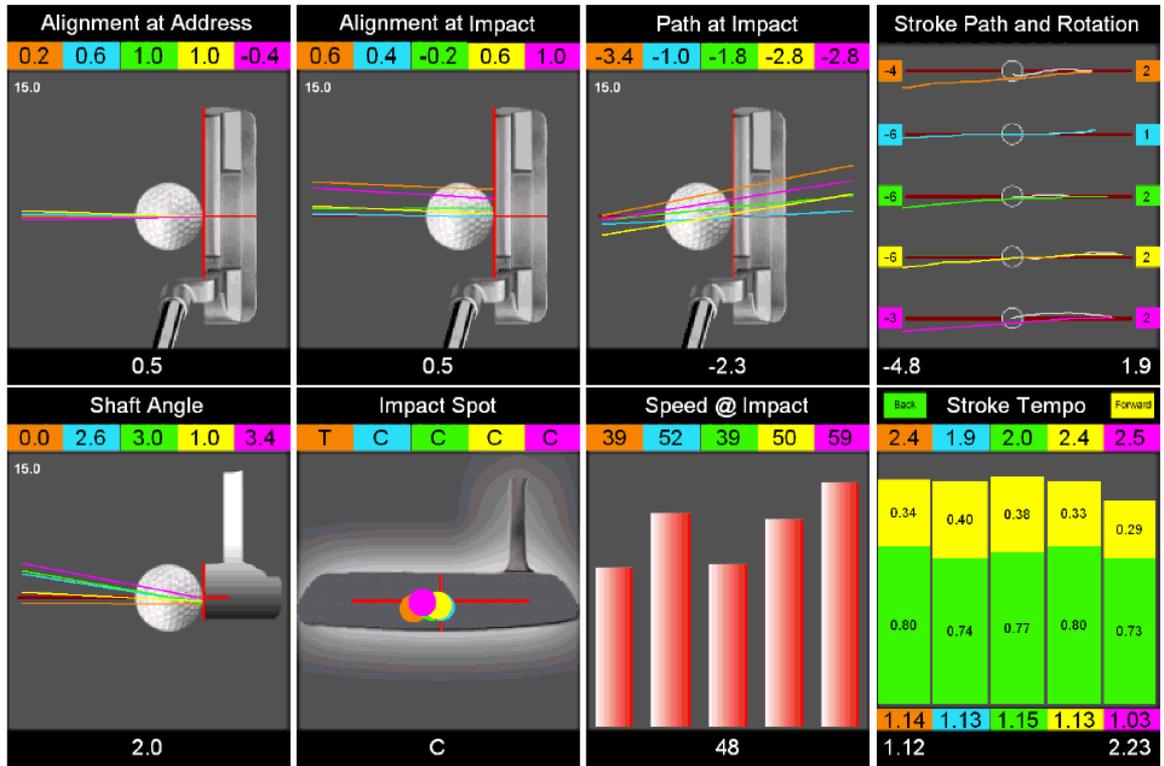|	-10.0	-5.0	0,0	5,0	10.0		
Shaft at impact	addloft				deloft	0.2 ° deloft
Height at impact	0,0 / low	5,0	10,0	15,0	20,0 / high	7.0 mm
Rise angle	-2,00 / down	0,50	3,00	5,50	8,00 / up	0.8° upward

Comparison of different speeds. First 3 slower, last 2 fast.
Tomi data speed is roughly correct for putt 1,3,5, wrong for putt 2 and 4. Timing is all over the place. Again path is not related to true data.
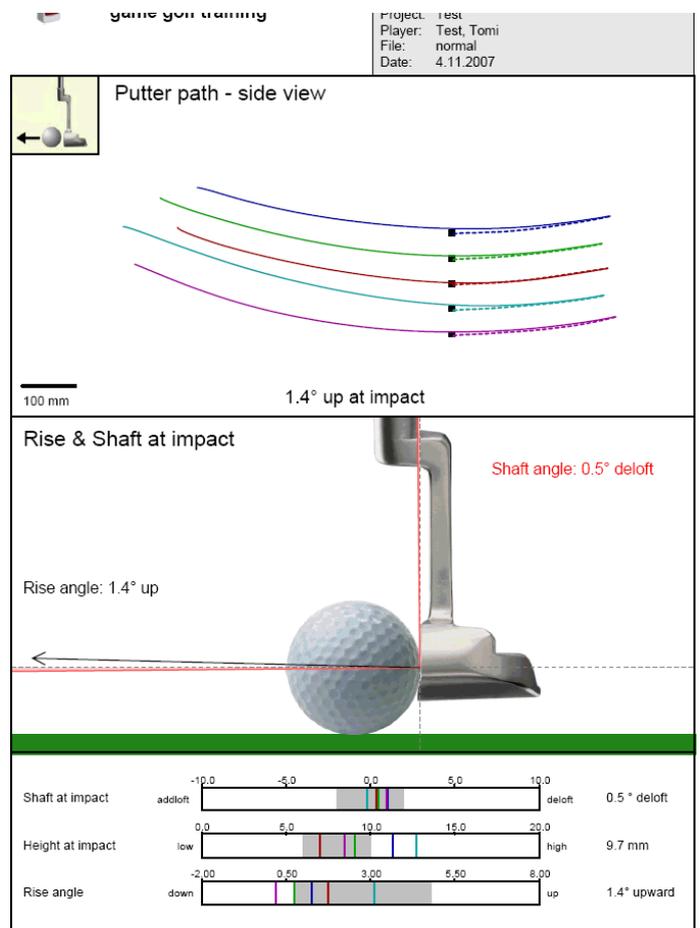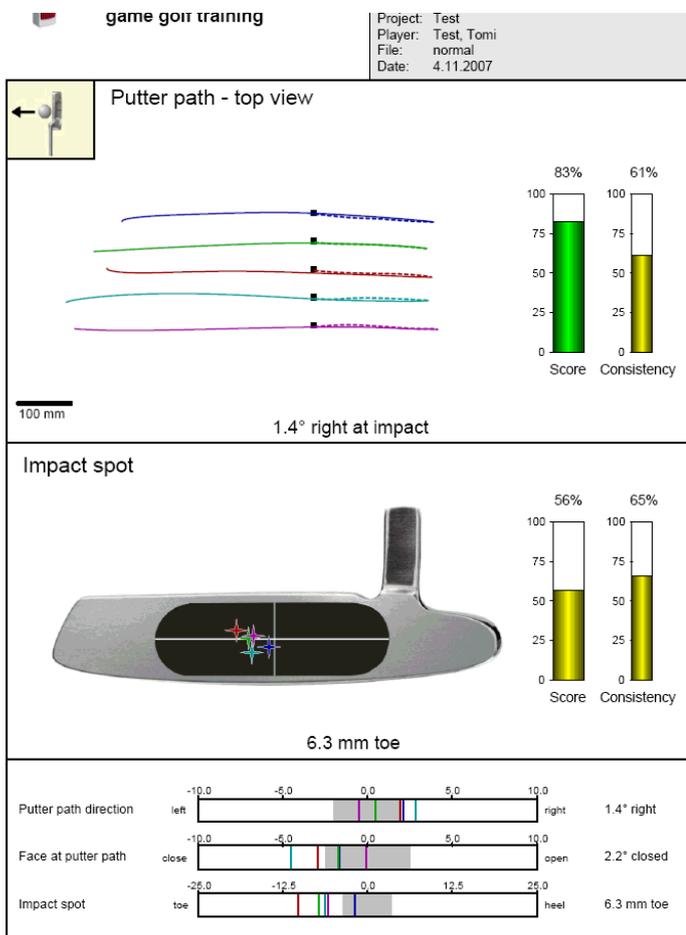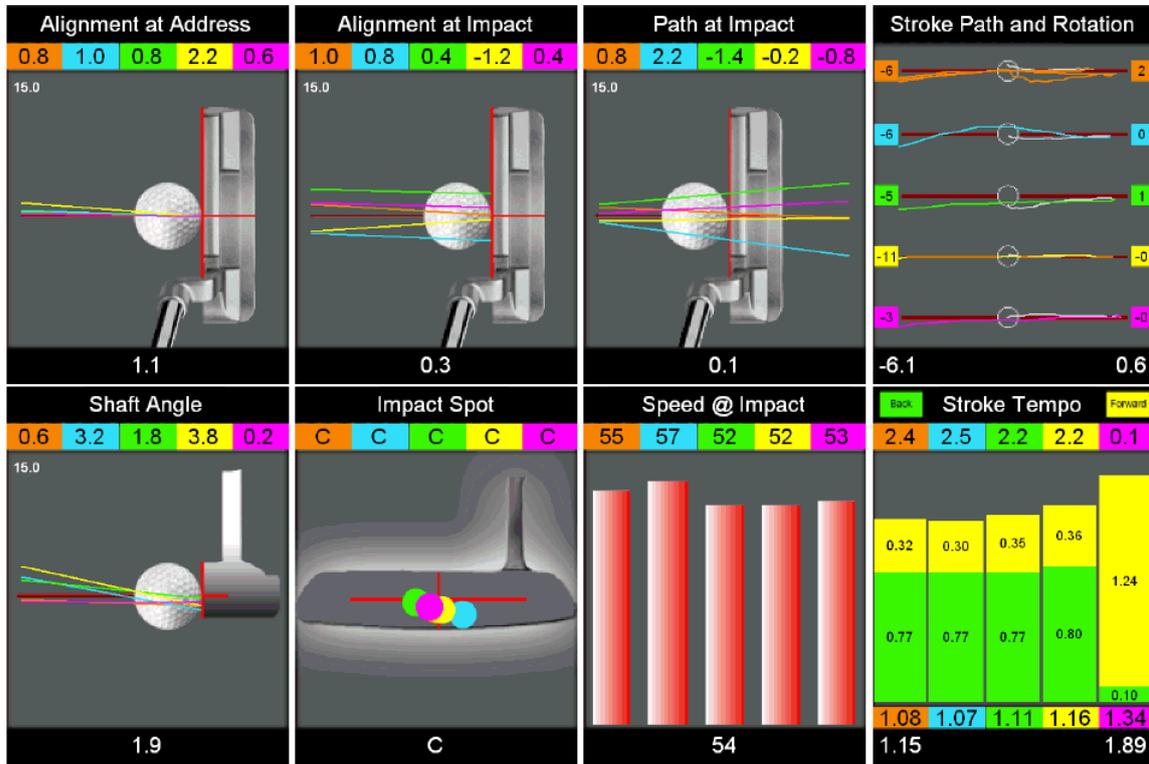
Comparison of a normal putting stroke.

Tomi data for Path and spot are again wrong. Stroke path data shows why. Data on Shaft angle is completely wrong.

Comparison of a normal putting stroke.

Tomi data for Speed and Timing are again wrong. Speed was consistent for all putts. Tomi shows slow for putt 3 and 5. Timing is different in SAM: 1-3 fast rhythm, 4,5 slow rhythm. Tomi shows constant rhythm. Values or timing are generally wrong, especially for time to impact and stroke tempo. Shaft angle again completely wrong.

Tomi

Stroke Report

Name: Test
Date: 11/4/2007 18:40:23
Title: rotation

Alignment at Address				
0.0	-0.2	0.8	0.2	0.4

0.2

Alignment at Impact				
-1.4	-0.2	-0.8	-0.4	-0.8

-0.7

Path at Impact				
-1.4	-2.8	-0.2	1.2	-0.2

-0.7

Stroke Path and Rotation	
-20	10
-17	15
-21	11
-21	13
-18	11

-19.3   12.0

Shaft Angle				
1.2	1.8	-0.2	2.4	3.4

1.7

Impact Spot				
C	C	C	C	C

C

Speed @ Impact				
50	50	44	58	45

49

Stroke Tempo (Back / Forward)				
2.2	2.2	2.1	2.2	2.1
0.35	0.39	0.38	0.37	0.36
0.77	0.83	0.80	0.80	0.77
1.12	1.22	1.18	1.17	1.13

1.16   2.15

game golf training

Project: Test
Player: Test, Tomi
File: rotation
Date: 4.11.2007

Putter path - side view

0.4° down at impact

100 mm

Rise & Shaft at impact

Shaft angle: 1.3° deloft

Rise angle: 0.4° down

	-10,0	-5,0	0,0	5,0	10,0		
Shaft at impact	addloft				deloft	1.3 ° deloft
	0,0	5,0	10,0	15,0	20,0		
Height at impact	low				high	7.7 mm
	-2,00	0,50	3,00	5,50	8,00		
Rise angle	down				up	0.4° down

game golf training

Project: Test
Player: Test, Tomi
File: rotation
Date: 4.11.2007

Movement Dynamics

-backswing-

-forward swing-

Speed [mm/s]

Acceleration [mm/s²]

Timing

Backswing time   737 ms

Time to impact   380 ms

Fwd. swing time   829 ms

	1,40	1,75	2,10	2,45	2,80	
Backswing Rhythm (Backswing time / Impact time)						1.94
	0,00	0,20	0,40	0,60	0,80	1,00
Impact timing (Impact time / fwd. swing time)						0.46
	750	1100	1450	1800	2150	2500
Speed at impact						1106 mm/s