



Ariel Dynamics Inc. Media Library - Video

Pacific Life Open



Code	adi-vid-01159
Title	Pacific Life Open
Subtitle	Analysis of Top Tennis Players
Description	Biomechanical analysis of world's top tennis players (Andre Agassi, Kim Clijsters, Roger Federer)
Subject	Sports;Tennis;Tutorials
Duration	00:23:17
URL	https://arielweb.com/videos/play/adi-vid-01159
Date	2006-07-13 15:59:29
Label	Approved
Privacy	Public

Synopsis

The video discusses a detailed analysis of a tennis player's movements, specifically focusing on the velocity changes and translation in their shots. The analysis is conducted using a sophisticated video analysis program that allows for a 3D view of the player's movements, tracing of specific points like the ball, the racket, and the player's hand, and the ability to view the motion from various angles.

The program also provides data on the velocity of the ball, showing how quickly it decreases after being hit. For instance, a serve that initially reaches 140 miles per hour can drop to 70 miles per hour by the time it reaches the ground.

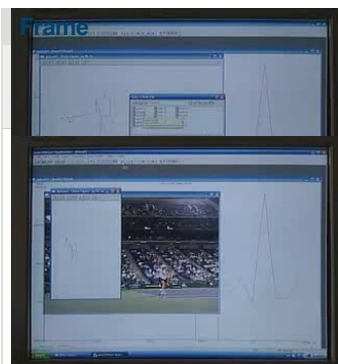
The analysis also reveals that the player's hand reaches maximum velocity at the moment of impact with the ball. The program allows for the synchronization of video with data, providing invaluable information for coaches to understand the player's performance better.

The video also mentions a comparison between different players' serves, suggesting similarities in their movements. The analysis concludes with a discussion on the continuous rotation observed in the player's movements, contrasting it with the backhand and forehand shots.

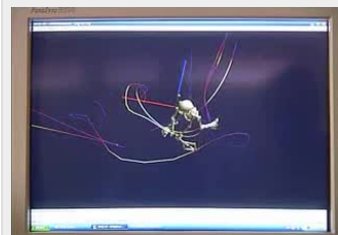
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Audio transcription

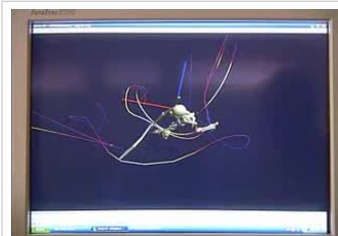
Frame	#	Time	Spoken text
	0.	00:00:00	So
	1.	00:00:28	in this area here there is increase velocity and suddenly there is decrease in velocity
	2.	00:00:35	which indicate there is a sum in this area there is some translation going on otherwise
	3.	00:00:42	that would continue to go up but it's going down and then it go up again after the impact.
	4.	00:00:49	So that's the proof that there is a translation going on.
	5.	00:00:55	If I go to Agassi 4N here and I'll put the video also and do the same thing with the
	6.	00:01:04	video you will see the same thing.
	7.	00:01:08	So in this area there is a decrease in velocity, definitely decrease in velocity which means
8.	00:01:19	that there is a translation going on.	



- | # | Time | Spoken text |
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| 9. | 00:01:23 | So if we look on all the three together up now we see the whole motion and I'll go back |
| 10. | 00:01:33 | and if I go and stop it right here and go frame by frame, there is increasing velocity |
| 11. | 00:01:42 | here and then there is decrease in velocity and that's indicated there is a translation. |
| 12. | 00:03:23 | You can look on it from the top and I think I can move it here. |
| 13. | 00:03:52 | There is one arrow here that was not traced but it's okay. |
| 14. | 00:04:01 | Now I can do also. |



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| 15. | 00:04:16 | Here you'll see the translation which is here. |
| 16. | 00:04:22 | You see? |
| 17. | 00:04:23 | Yeah. |
| 18. | 00:04:24 | So there is a translation. |
| 19. | 00:04:25 | You see there is a lot of rotation here and there is a sunset but it's not 100% translation |



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| 20. | 00:04:28 | but that's very good. |
| 21. | 00:04:29 | That's his argument, he just made his argument here. |
| 22. | 00:04:36 | And there is an arrow but the arrow happened after the impact so that's not the problem. |
| 23. | 00:04:46 | So in this case of Kleister, the coach was interested in the speed of the ball, the |
| 24. | 00:05:03 | speed of the racket as you see here. |



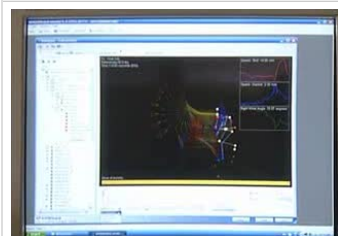
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| 25. | 00:05:06 | So in this case of Kleister, the coach was interested in the speed of the ball, the |
| 26. | 00:05:25 | speed of the racket as you see here and the right wrist. |
| 27. | 00:05:31 | And in order to see it immediately, I go to the renderer, in this case it's Kleister. |
| 28. | 00:05:39 | And here you'll see the wrist angle. |
| 29. | 00:05:43 | If I want to add in this case the speed of the ball, use the speed of the ball. |



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| 30. | 00:05:49 | If I want to look on the right, if the speed of the racket, use the speed of the racket. |
| 31. | 00:05:57 | I'll take the rotation out and look on it from every angle. |
| 32. | 00:06:04 | And if I want to see them all three, here are all the three together. |
| 33. | 00:06:15 | So all the information that the coach wants to see will show here and at the same time |
| 34. | 00:06:23 | will show the outlet in a hair movement, in this case it's Kleister. |

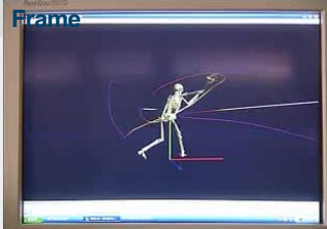
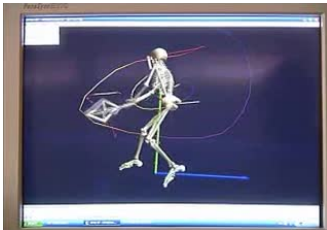

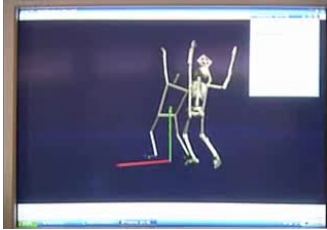
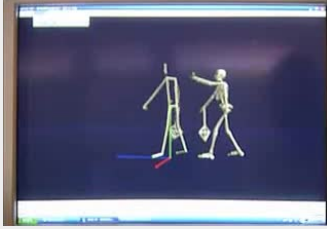
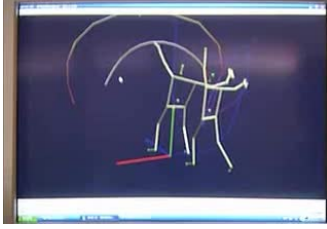
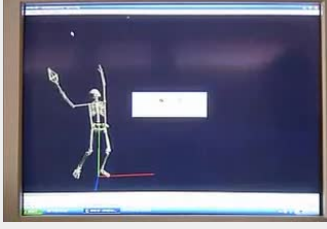




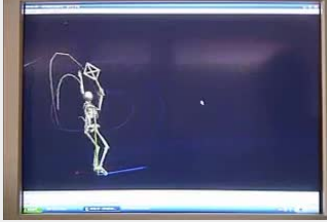


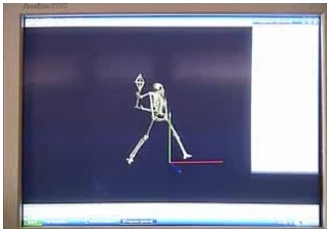
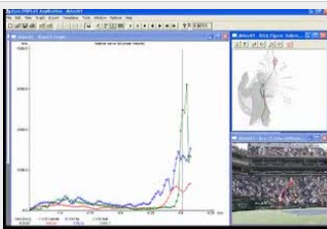
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| 35. | 00:06:27 | Now if we want to look on different events, if I just want to look on this event, here's |
| 36. | 00:06:33 | this event. |
| 37. | 00:06:34 | And this event was actually the start activity, if I go to the start activity, that's it. |
| 38. | 00:06:45 | The other event is the ball impact, here it is. |
| 39. | 00:06:48 | The other one is the end of the activity, here is the end of the activity. |

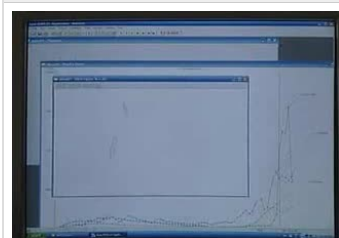
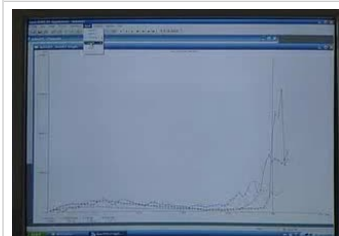
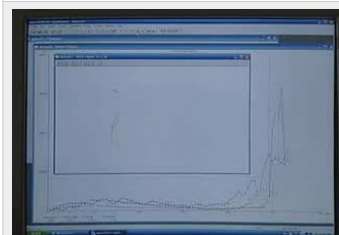
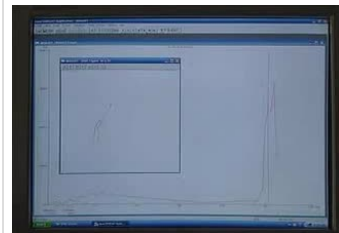
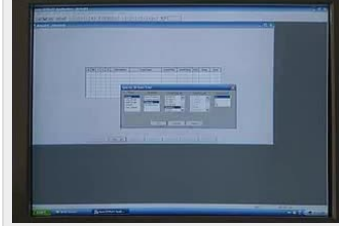


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| 40. | 00:06:52 | Now I'll take the, all the frame here, so it will be shown again. |
| 41. | 00:06:58 | If I want to go to the start of the activity, I can show every event at different time. |
| 42. | 00:07:04 | Here it is, if I go to here, this is the second event and this is the third event, the end |
| 43. | 00:07:13 | of the activity. |

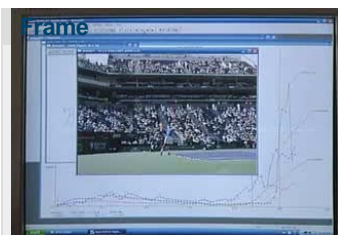
Frame	#	Time	Spoken text
	44.	00:07:14	<i>So that's the beginning of the activity, the impact and the end of the activity.</i>
	45.	00:07:22	<i>And you see here the vertical bar, show you exactly where it happened on the parameters</i>
	46.	00:07:27	<i>of interest.</i>
	47.	00:07:28	<i>Let's say a position here, the position here, event here and event here.</i>
	48.	00:07:35	<i>So now I'll see and process it, now I'll say more images because I created new events.</i>
	49.	00:07:44	<i>So basically you're creating a strobing of this activity and you see it's a little bit</i>
	50.	00:07:48	<i>blur here, but this is the activity that we selected in this case.</i>
	51.	00:07:55	<i>And also you can see the stick figures in the background of this particular motion.</i>
	52.	00:08:04	<i>So the wizard gives the coach the ability quickly to define parameters and show it right</i>
	53.	00:08:13	<i>away on the screen in any form that you want.</i>
	54.	00:08:20	<i>So this is Kleister's in her backhand.</i>
	55.	00:08:23	<i>I can put the frame in store here.</i>
	56.	00:08:30	<i>I can rotate it in 3D, look on it from any angle.</i>
	57.	00:08:35	<i>I can look on the different parameters again here, like the speed of the ball, here's the</i>
	58.	00:08:40	<i>speed of the ball.</i>
	59.	00:08:42	<i>You see here, if I want the speed of the racket, here's the speed of the racket.</i>
	60.	00:08:48	<i>If I want to look on the right wrist angle, here's the right wrist angle, and if I want</i>
	61.	00:08:54	<i>all of them together, here are the all together.</i>
	62.	00:09:00	<i>So that's incredible, you see here, if I want the speed of the racket, here's the speed</i>
	63.	00:09:06	<i>of the racket.</i>
	64.	00:09:10	<i>If I want to look on the right wrist angle, here's the right wrist angle, and if I want</i>
	65.	00:09:16	<i>all of them together, here are the all together.</i>
	66.	00:09:21	<i>So that's incredible level of information that can be drawn really quick from the video</i>
	67.	00:09:30	<i>analysis.</i>
	68.	00:09:32	<i>This is the most advanced program in the world that can do all this thing, where it</i>
	69.	00:09:38	<i>combines strobing, videos, stick figures, kinematic information, and results.</i>
	70.	00:09:45	<i>On the side, okay, so here she is, and would be interesting if she's doing the same thing.</i>
	71.	00:09:52	<i>So if we look on it from the top, and we'll move it a little bit.</i>
	72.	00:10:00	<i>So it's very similar thing here.</i>
	73.	00:10:08	<i>There is a lot of rotation, and yield translation, a little bit less than Agassi, or the swing,</i>
	74.	00:10:16	<i>when you see the whole thing, how it goes here.</i>
	75.	00:10:20	<i>And then if we reset it to the side, and we can turn it around, that's very nice shots</i>

	#	Time	Spoken text
	76.	00:10:29	<i>here.</i>
	77.	00:10:30	<i>And make it a little bit bigger.</i>
	78.	00:10:45	<i>Very nice, okay.</i>
	79.	00:10:47	<i>So we got that.</i>
	80.	00:10:48	<i>Now we do file.</i>
	81.	00:10:57	<i>So I'm loading now at the render.</i>
	82.	00:11:07	<i>I'll open, in this case, I'll take Federer's serve, and I'll transfer it into a skeletal</i>
	83.	00:11:23	<i>view.</i>
	84.	00:11:27	<i>And then I'll add to that, Kleister, Kleister, serve, so I'll do file.</i>
	85.	00:11:34	<i>Open, in this case, I'll take Kleister's serve, which is here.</i>
	86.	00:11:40	<i>So here you'll see the best men, and the best women.</i>
	87.	00:11:45	<i>Everything very, very similar.</i>
	88.	00:11:55	<i>And if I put the skeleton, here's a bigger, I want to put the properties here.</i>
	89.	00:12:09	<i>If I put it in a skeleton, it will not be as good view, now if I put the other one,</i>
	90.	00:12:24	<i>this is Kleister, and I want to see, that's Kleister.</i>
	91.	00:12:39	<i>I'll put this, yeah, it's giving me the only the current one.</i>
	92.	00:12:56	<i>But that's still good, and it looks like they're into the same school serving.</i>
	93.	00:13:07	<i>You'll see only the points, the joint centers, for one.</i>
	94.	00:13:16	<i>And then you can look on it from different angle.</i>
	95.	00:13:19	<i>If I actually go to the option and close the constrain to the novertical, I can look on</i>
	96.	00:13:25	<i>it from up or down.</i>
	97.	00:13:31	<i>And also I can put different traces.</i>
	98.	00:13:35	<i>So if I go to the points and I want to trace, for example, different segments like the ball,</i>
	99.	00:13:41	<i>the tip of the racket, the handle, I can see all this thing at the same time, and it can</i>
	100.	00:13:49	<i>make a comparison here.</i>
	101.	00:13:53	<i>Yeah, very, very similar serve.</i>
	102.	00:13:59	<i>See, but the ball's a very, very strong serve.</i>
	103.	00:14:06	<i>See, she's taking her legs a little bit sooner, but very, very similar, almost like if they</i>
	104.	00:14:15	<i>had the same coach.</i>
	105.	00:14:32	<i>And if we want to see against certain points, we'll go points and we'll go same kind of</i>
	106.	00:14:40	<i>points.</i>
	107.	00:14:41	<i>Go to central gravity, the ball, the tip of the racket, yeah, that's the tip of the</i>
	108.	00:14:47	<i>racket.</i>
	109.	00:14:48	<i>The racket's all around on your back.</i>
	110.	00:14:53	<i>That we have to go to the kinematic, but slow, you mean, you see the, yeah, that's why</i>
	111.	00:15:02	<i>it</i>
	111.	00:15:02	<i>looked bluish.</i>
	112.	00:15:03	<i>And then the more, the whiter it gets, the faster it is.</i>
	113.	00:15:08	<i>So if you look on the, that's the tip of the racket.</i>

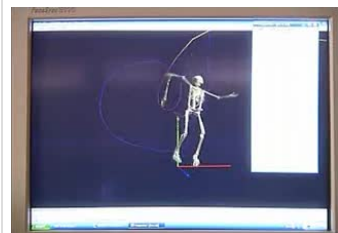
	#	Time	Spoken text
	114.	00:15:13	So it's the fastest here, because it's the whitest, you see, it's going boom.
	115.	00:15:18	And of course, the ball getting there, you can look on it from all angles, upside down
	116.	00:15:24	everywhere you want, move it here.
	117.	00:15:28	And reset it to where it was.
	118.	00:15:59	We have Fedor here, so we'll select Fedor backhand in this case.
	119.	00:16:07	We can do a quick render, so here you see the motion, there is also a rotation here,
	120.	00:16:13	which I'll take the rotation out, so you see the whole segment of this particular thing.
	121.	00:16:24	We can rotate him, so while he's doing it, we see it from every angle, that's all three-dimensional.
	122.	00:16:35	And we can do different kind of tracing, for example, I can show the frame history, so
	123.	00:16:40	it shows the whole motion while he's doing it.
	124.	00:16:52	And here you'll see also different curves, these are the parameters that a particular
	125.	00:16:55	coach, in this case Mr. Braden, are interested in, but different coaches might be interested
	126.	00:16:59	in different things.
	127.	00:17:01	I can have also all the frames, so it shows all the frames going and going right through
	128.	00:17:06	the frames.
	129.	00:17:08	Another perspective, and of course it's all in three-dimensional, so I can move it.
	130.	00:17:14	And also we'll add some points here.
	131.	00:17:18	So again, the ball, the central gravity, the tip of the racket, and the right hand.
	132.	00:17:26	And then you see Fedor here.
	133.	00:17:39	Translation here, very, very important.
	134.	00:17:43	And then rotation again.
	135.	00:17:45	So there is an area where there is deceleration of the racket, basically.
	136.	00:17:52	Of the hand of the racket.
	137.	00:17:54	That's what's creating the whip.
	138.	00:17:56	We're going from all translation here, very, very important.
	139.	00:18:04	And then rotation again.
	140.	00:18:06	So there is an area where there is deceleration of the racket, basically.
	141.	00:18:13	Of the hand of the racket.
	142.	00:18:15	That's what's creating the whip.
	143.	00:18:18	I'm going from all the angles.
	144.	00:18:24	I'm going from the top.
	145.	00:18:43	OK, what I wanted to show is that I'll go now to the display and I'll show I'll continue
	146.	00:18:58	with the recording.
	147.	00:19:00	That's good.
	148.	00:19:01	Do you want to continue?
	149.	00:19:02	Yeah, yeah.
	150.	00:19:03	Just to show it.
	151.	00:19:04	And if I go to the display and just look on the velocity of the ball, which is very critical.



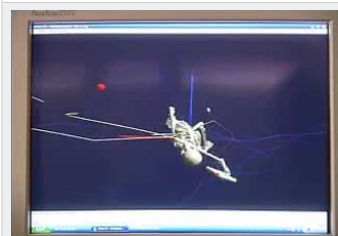
#	Time	Spoken text
152.	00:19:08	Let's say 140 miles an hour, 130 miles an hour, however, I want to show how the ball
153.	00:19:14	of the velocity is changed direction, it's changed velocity so fast.
154.	00:19:19	So if I take, for example, Fedor serve, which was 140 miles an hour, and I just do linear
155.	00:19:25	velocity of the ball in 3D.
156.	00:19:30	And I'll graph it.
157.	00:19:34	So this is the velocity of the ball, and I'll put the stick figure here.
158.	00:19:41	So now when I'm going all the way to the hit, to the impact, which is to happen here, look
159.	00:19:49	what happened to the velocity of the ball.
160.	00:19:51	It reached peak velocity, but it dropped velocity very, very quick.
161.	00:19:55	So from 140 miles to 120 miles, it dropped it in only a few seconds, less than a second.
162.	00:20:01	So when people say it's 140 miles an hour, by the time it reached the ground, it's maybe
163.	00:20:06	only 70 miles an hour.
164.	00:20:08	So that's very important to, now we have the whole process of the serve.
165.	00:20:15	And if we go frame by frame back to the impact, which was here, you see where the impact here.
166.	00:20:23	And obviously that's happened when the hand is in maximum velocity, which makes sense.
167.	00:20:29	And the tip of the racket, maximum velocity, so the hand, the tip of the racket, and of
168.	00:20:34	course the ball going much faster even.
169.	00:20:36	In fact, if we want to measure it, we can go to the tools, label.
170.	00:20:42	We have to look on this particular one in a second, so we'll go to tools, label, add
171.	00:20:48	and I'll add a value on the Y. And if I want to know what was the velocity of the ball
172.	00:20:54	at maximum velocity, it was 3,007 inches per second, which is about 140 miles an hour.
173.	00:21:04	We can do the conversion, in this case we have it in inch per second.
174.	00:21:09	If we look on the hand, the hand was 1,439 inches per second.
175.	00:21:18	If we look on the, I'm sorry, that was the tip of the racket.
176.	00:21:21	If we look on the hand now, the red is the hand.
177.	00:21:25	It's 527 inches per second.
178.	00:21:29	And if we want to look on the, well, we saw already the ball, which is here 3,107.
179.	00:21:34	Now if I'm bringing it back, then, okay, we'll get out of here, we'll bring the stick figure
180.	00:21:43	back.
181.	00:21:44	Now I want to add the video.
182.	00:21:48	We also have the video with all the data, so they're all synchronized together to show
183.	00:21:55	you the whole process of the analytical process, to find out what it's doing, see the video,
184.	00:22:03	see the stick figures, and see the results, in this case, are 3 parameters, but we can
185.	00:22:08	go to any body segment to show the same thing, so I can go frame by frame.
186.	00:22:14	This invaluable information for the coach to understand what's really going on in the
187.	00:22:19	process of this particular performance by Federal, Warner, or maybe number one tennis
188.	00:22:27	player in the world in this time.



#	Time	Spoken text
189.	00:22:32	<i>And again, we'll take points, and we'll make it few more segments, so the central gravity,</i>



190.	00:22:38	<i>the ball, the tip of the racket, and the right hand.</i>
191.	00:22:45	<i>Okay, we'll look on it for more size.</i>
192.	00:22:51	<i>This was by the way, 140 miles an hour, we calculated.</i>
193.	00:22:57	<i>But one more thing that I want to show here in a second, make it a little bit bigger,</i>
194.	00:23:04	<i>make it up, you can look on it from the top, and the thing is that we didn't have</i>



195.	00:23:14	<i>come around the top, but this is what 3D will do for you.</i>
196.	00:23:21	<i>And interesting enough, if I look here, now turn him around, is that if I stop the racket</i>
197.	00:23:34	<i>now, you see that here, he's going down, and the rotation continues, there is no translation.</i>
198.	00:23:44	<i>It continues all the way as compared to the back hand and the forehand.</i>
199.	00:23:49	<i>So what Vic said is absolutely correct.</i>

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