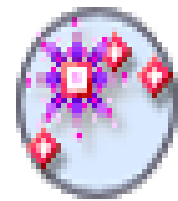


Tracker的應用

10131廖子淇

Tracker



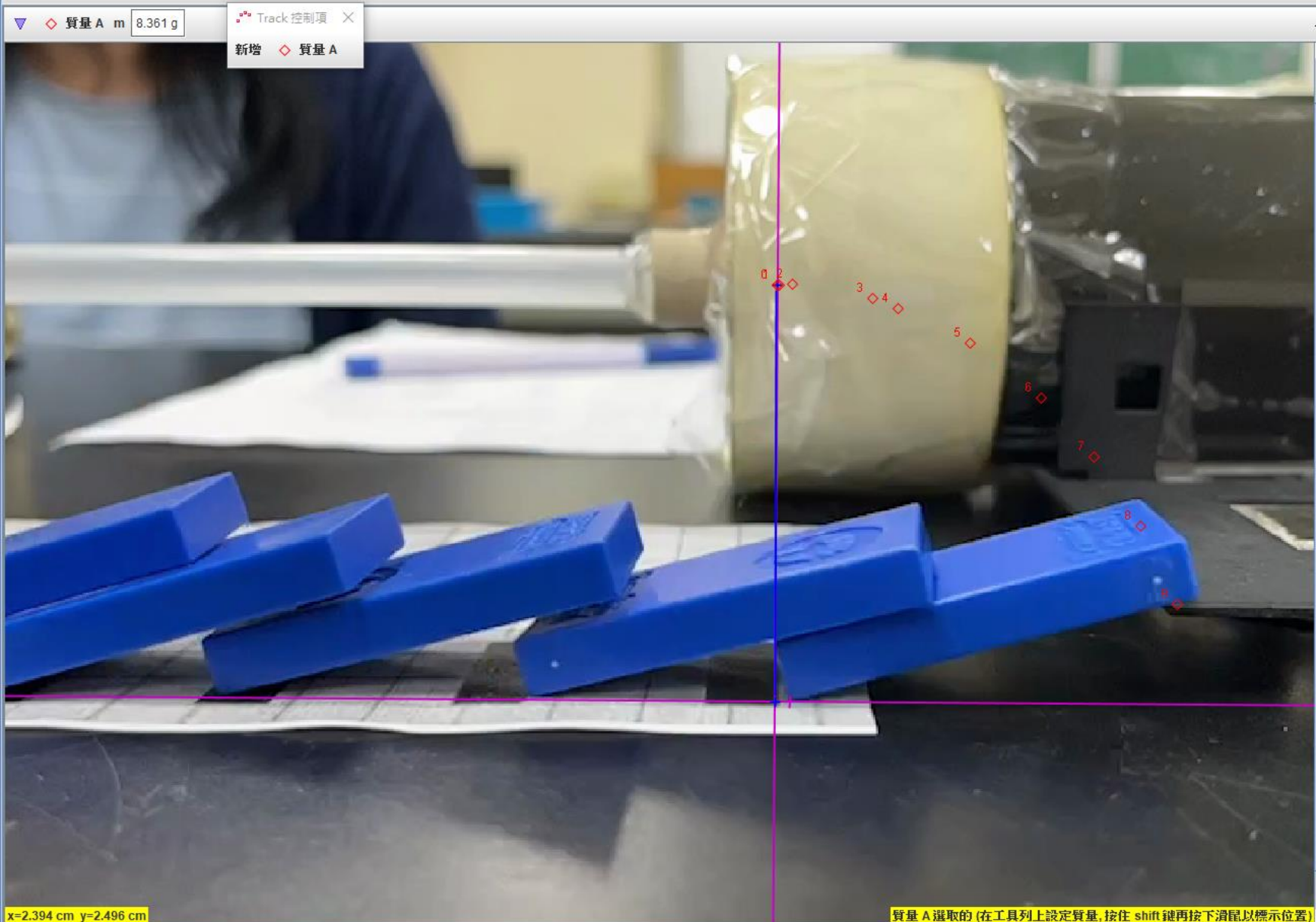
Tracker

Video Analysis and Modeling Tool

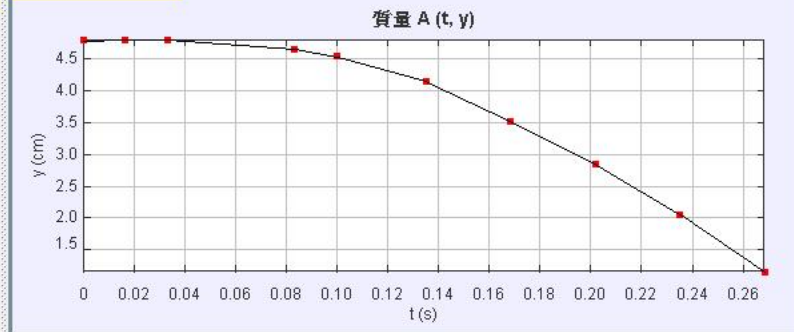
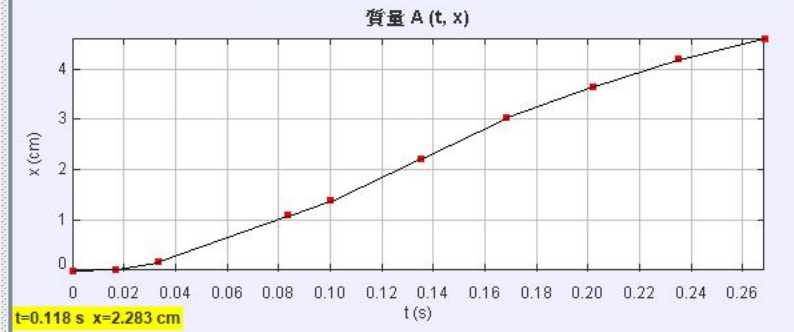
小論文研究動機

推倒一片小小的骨牌，便能使上千張甚至上萬張骨牌一同倒下，還能創造出許多文字或圖案，如此神奇的骨牌，讓我們好奇其中的奧秘，骨牌與骨牌間的距離和其倒下的速率的關係是什麼？轉彎中的骨牌會倒得比較慢嗎？這些的問題使我們做了以下的研究。





繪圖 質量 A 同步



表格資料 質量 A

t(s)	x(...)	y(...)	r(...)	θ_r	v_x	v_y	$v(...)$	θ_v	a_x	a_y	$a(...)$	θ_a	θ	ω	α	st...	fr...	p_x	p_y	$p(...)$	θ_p	pixe	pixe	L
0...	-5...	4...	4...	9...									9...			0	517					4...	1...	0
0...	2...	4...	4...	8...	5...	0...	5...	4...					8...	-6...		1	518	4...	3...	4...	3...	4...	1...	2
0...	0...	4...	4...	8...	1...	-2...	1...	-7...	3...	-9...	3...	-1...	8...	-1...	-3...	2	519	1...	-1...	1...	-6...	4...	1...	0
0...	1...	4...	4...	7...	1...	-4...	1...	-1...	1...	-1...	1...	-4...	7...	-2...	-1...	3	520	1...	-3...	1...	-1...	5...	1...	1
0...	1...	4...	4...	7...	2...	-9...	2...	-2...	4...	-1...	1...	-7...	7...	-2...	-1...	4	521	1...	-8...	2...	-2...	5...	1...	1
0...	2...	4...	4...	6...	2...	-1...	2...	-3...	1...	-2...	2...	-6...	6...	-3...	-2...	5	522	2...	-1...	2...	-2...	5...	1...	2
0...	3...	3...	4...	4...	2...	-1...	2...	-4...	-9...	-1...	1...	-1...	4...	-3...	1...	6	523	1...	-1...	2...	-3...	6...	2...	3
0...	3...	2...	4...	3...	1...	-2...	2...	-5...	-1...	-8...	1...	-1...	3...	-3...	9...	7	524	1...	-1...	2...	-4...	6...	2...	4
0...	4...	2...	4...	2...	1...	-2...	2...	-6...					2...	-3...		8	525	1...	-2...	2...	-5...	6...	2...	5
0...	4...	1...	4...	1...									1...			9	526					6...	3...	6

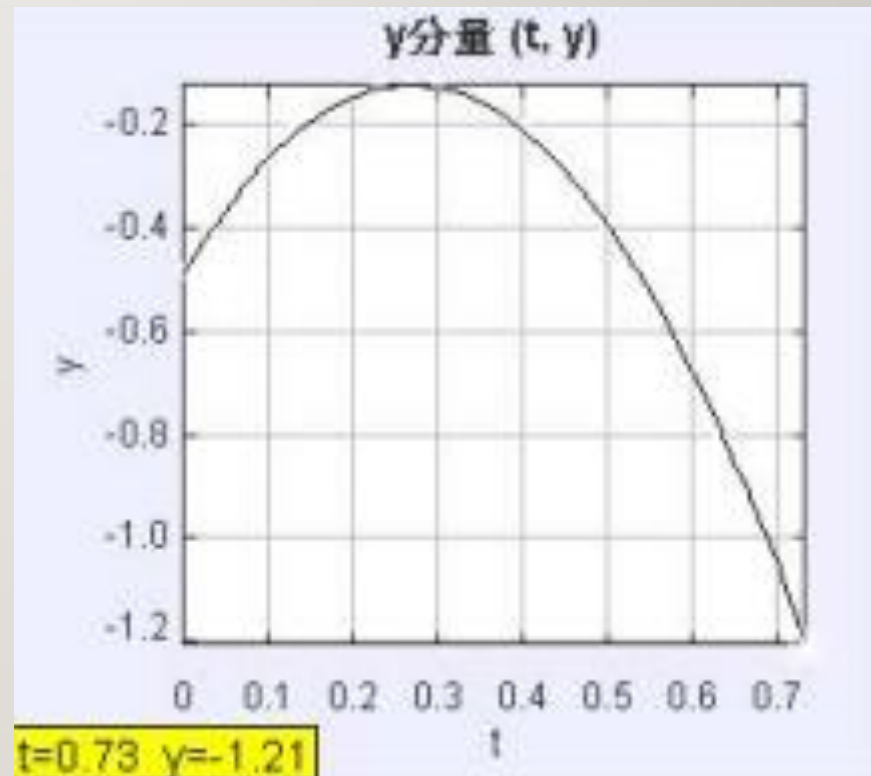
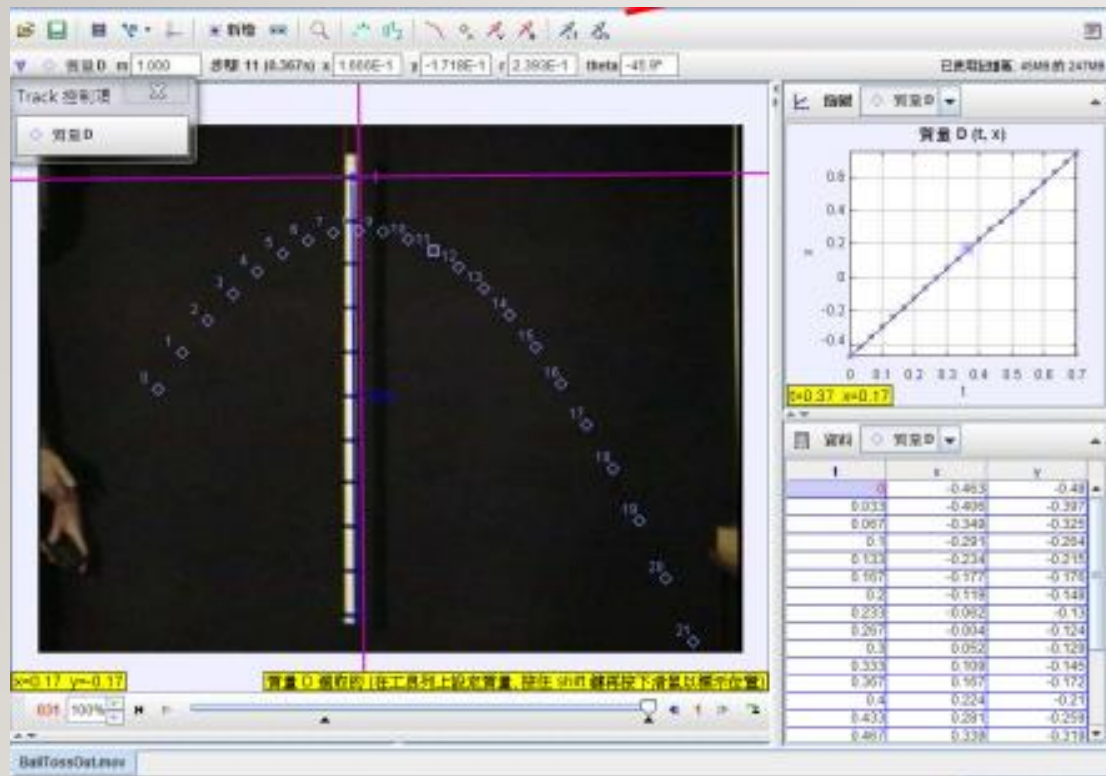
x=2.394 cm y=2.496 cm

質量 A 選取的 (在工具列上設定質量, 按住 shift 鍵再按下滑鼠以標示位置)

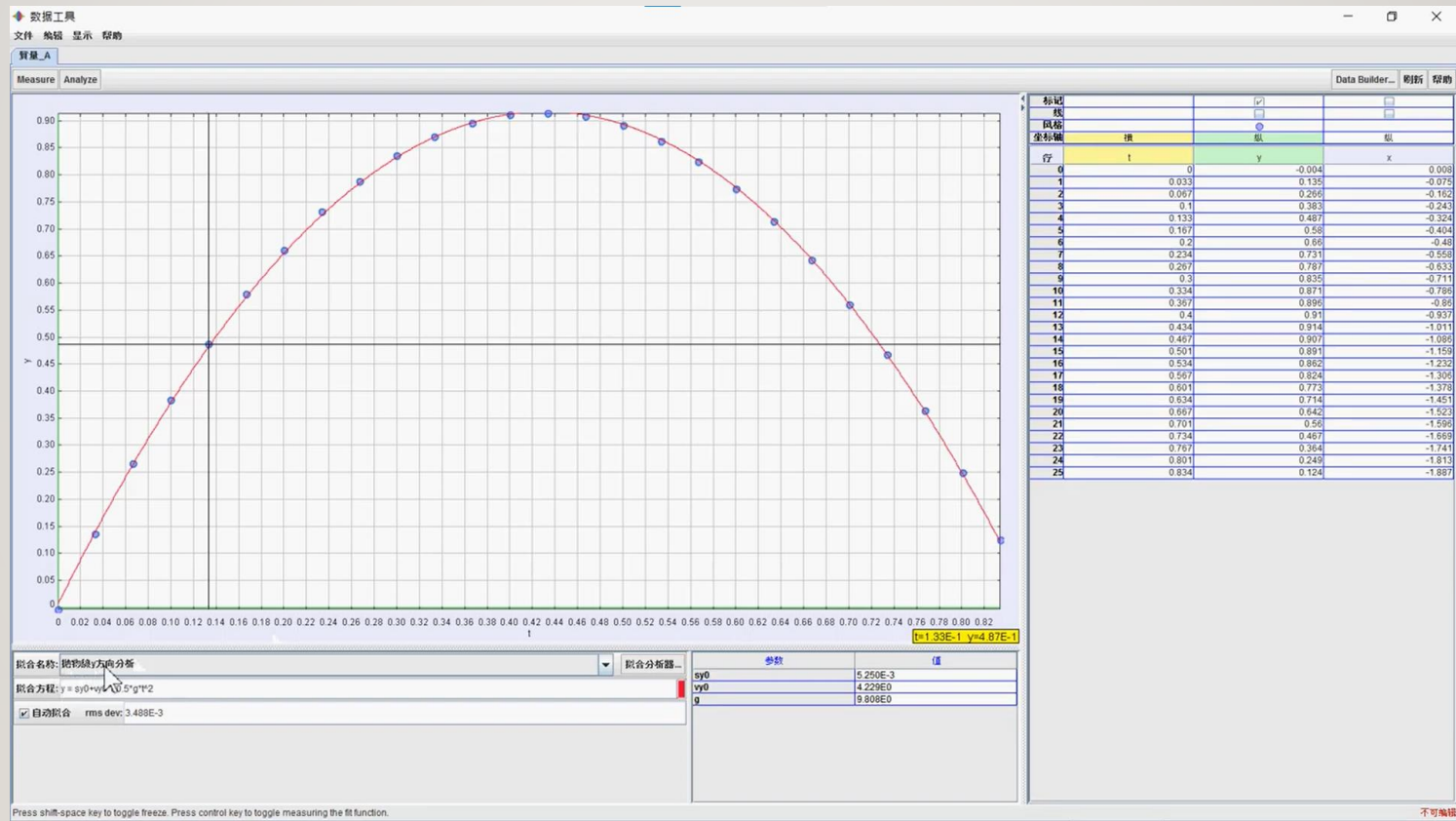
Tracker的應用

- 1. 二維運動：如拋體運動
- 2. 軌跡分析：利用擬合的方程式做軌跡預測
- 3. 週期運動：單擺
- 4. 多體問題：二維碰撞
- 5. 光譜分析

1. 二維運動



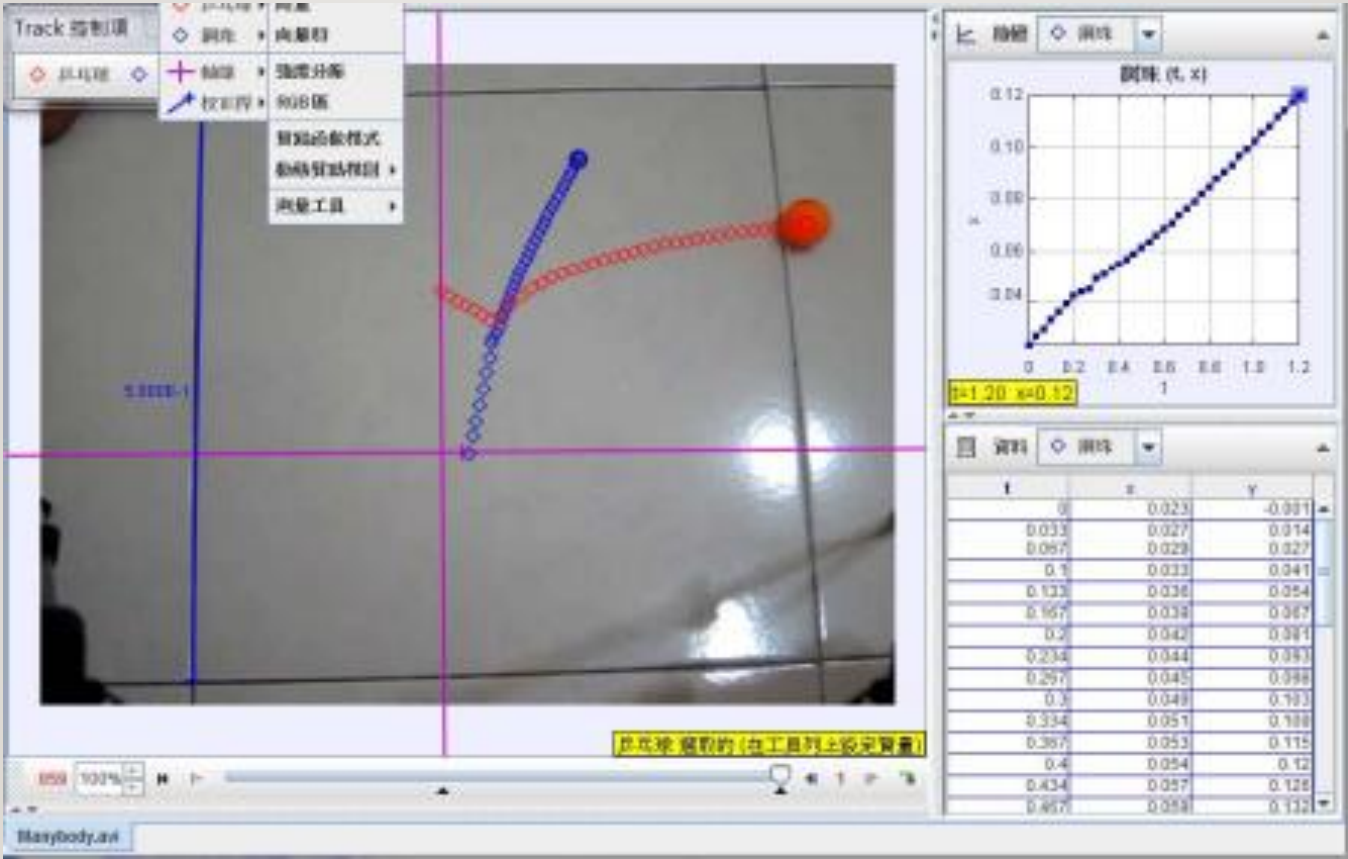
2.軌跡分析



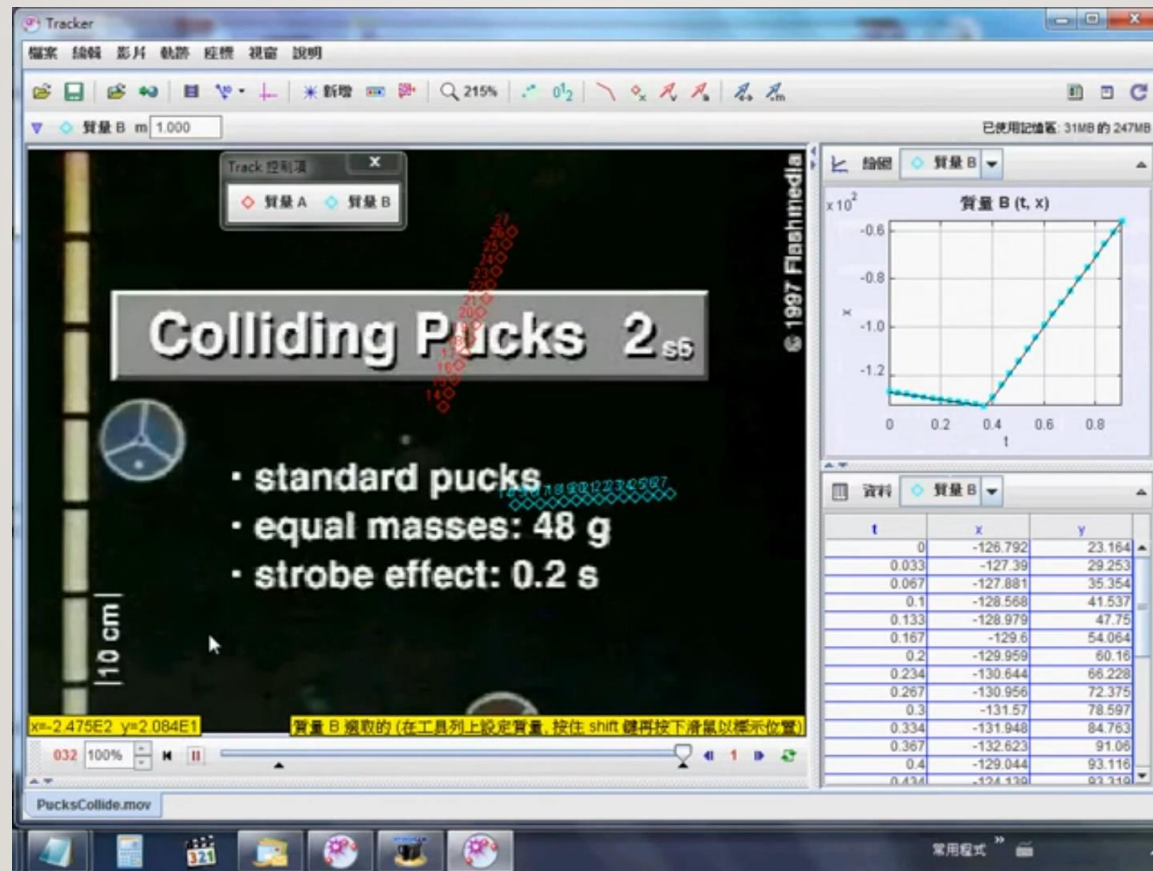
3. 週期運動

The screenshot displays a software interface for tracking a pendulum's motion. The main window shows a video of a pendulum with a red dot and a dashed box indicating the tracked mass. The coordinates are $x = -1.142E2$ and $y = -4.03E1$. The mass is labeled as $mass A$ with a value of $m = 1.000$. The plot window shows the position x versus time t for $mass A$, with a red line representing the data. The plot title is $mass A (t, x)$. The plot shows a curve that starts at $x \approx 5$ at $t = 0$, remains relatively constant until $t \approx 0.6$, then drops sharply to $x \approx -20$ at $t = 1.0$. The interface includes a menu bar (File, Edit, Video, Track, Coordinate System, View, Help), a toolbar with various tools, and a status bar at the bottom showing the file name `pendulum_drag.mov`. The right panel contains controls for the autotracker, including a `Stop` button, `Search This` and `Search Next` buttons, and a `Template` section with `Evolution Rate` set to 20% and `Automark` set to 4. The `Search` section has `X-axis Only` unchecked and `Look Ahead` checked. The `Target` section is set to `Track` for `mass A` at `position`. A message at the bottom of the right panel states: "Frame 35: No match was found in the search area shown. Your options are: --modify the search area and search again --shift-click to mark manually --step back and change the evolution rate or shift-control-click to define a new key frame this time, frame and continue with the search".

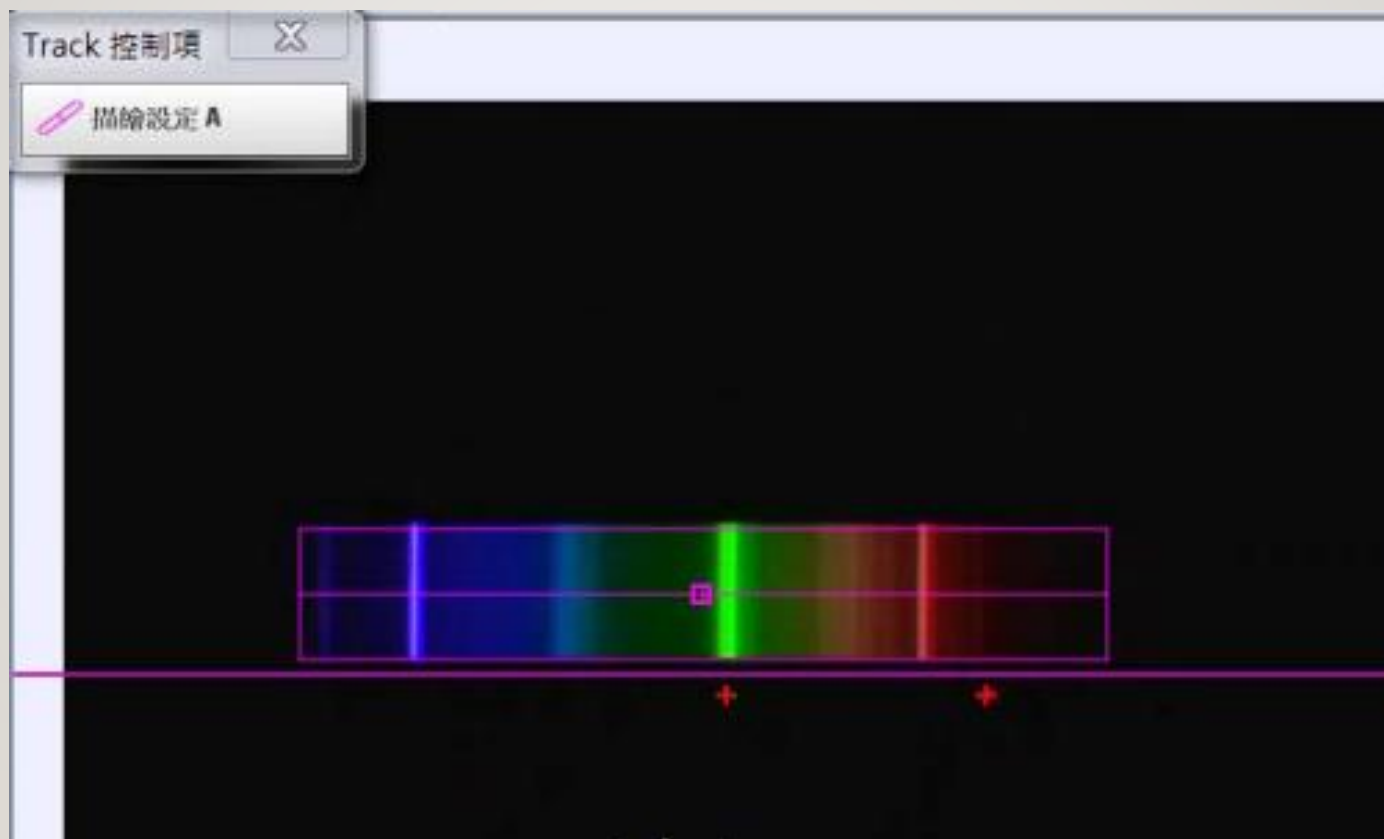
4. 多體問題



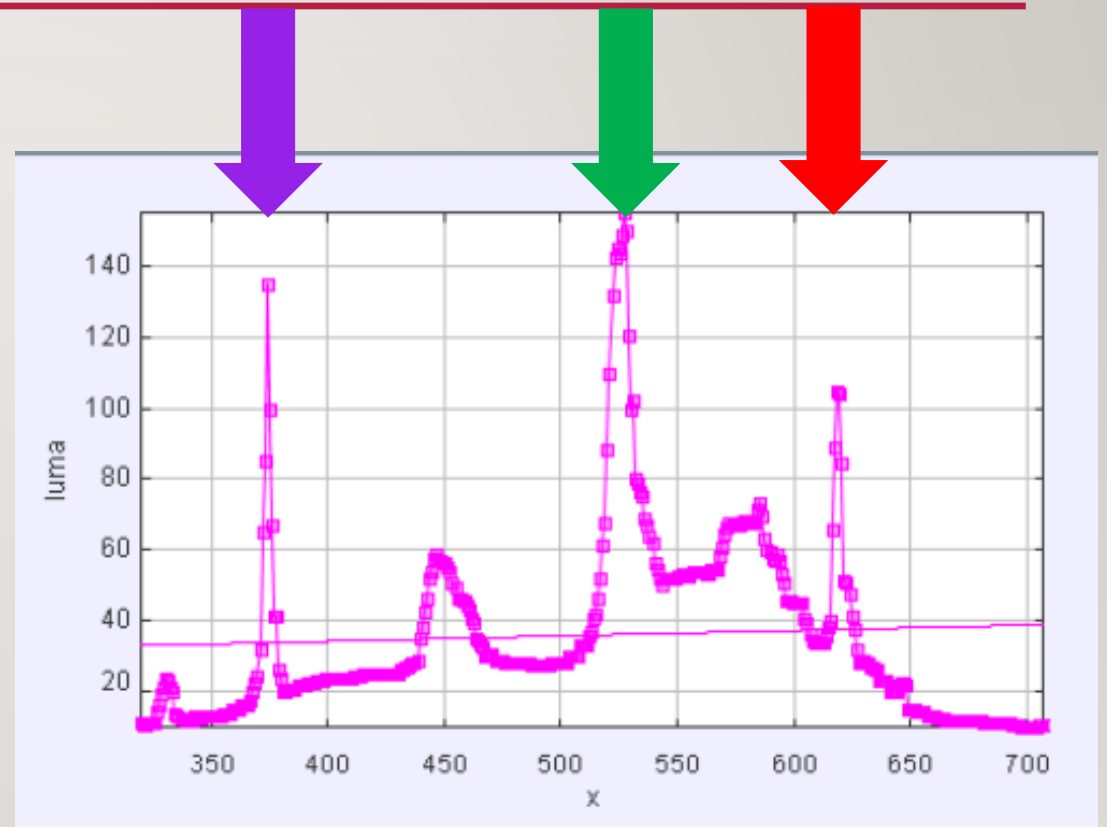
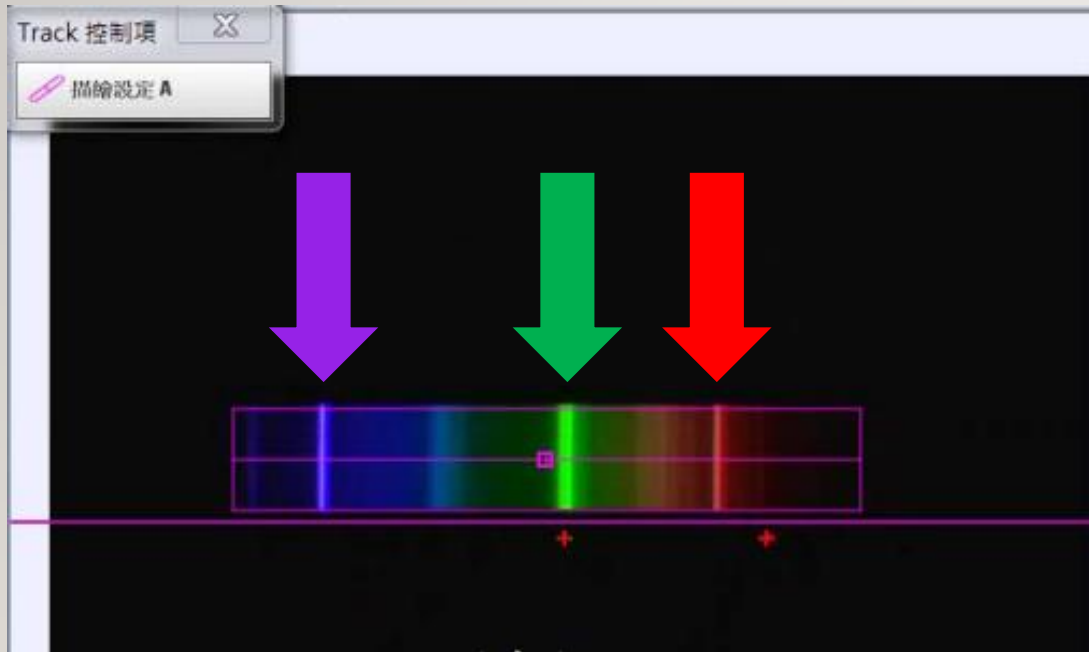
4. 多體問題



5.光譜分析

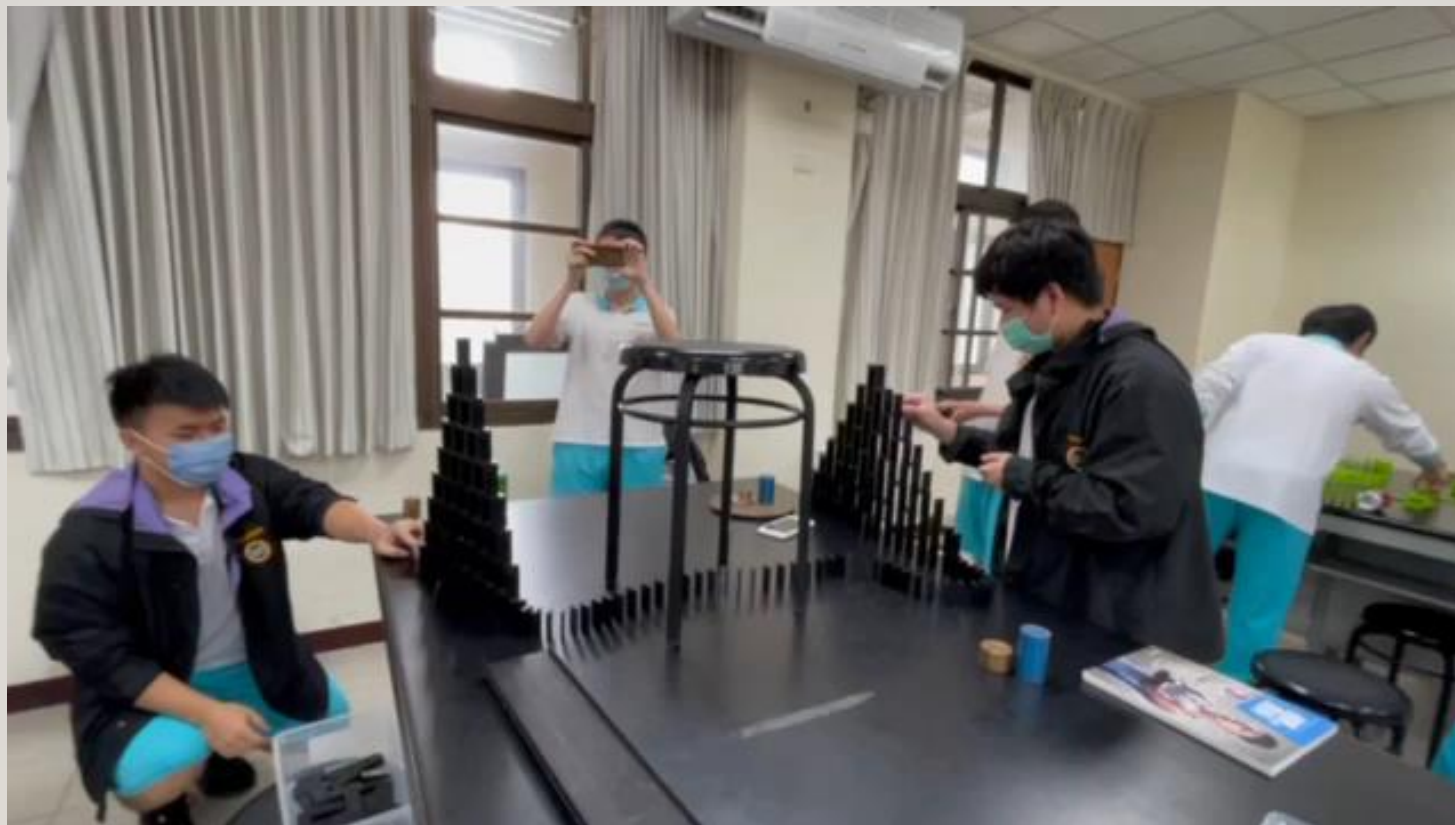


5.光譜分析



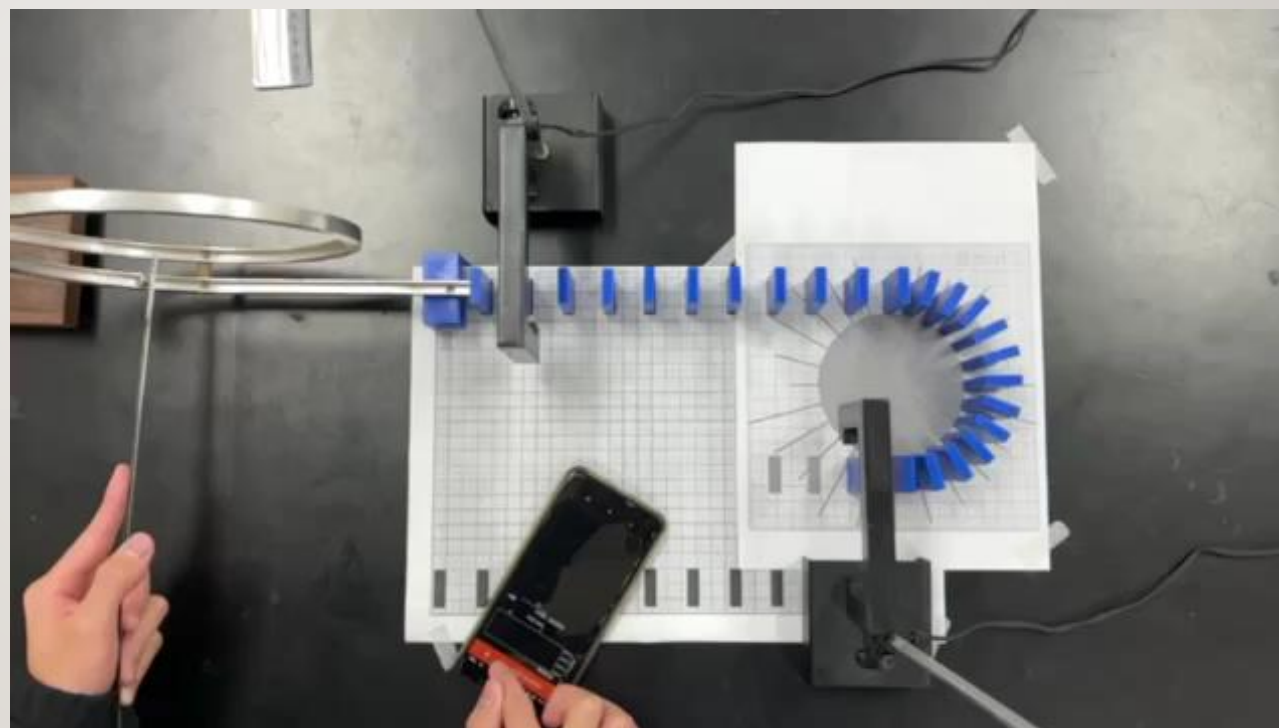
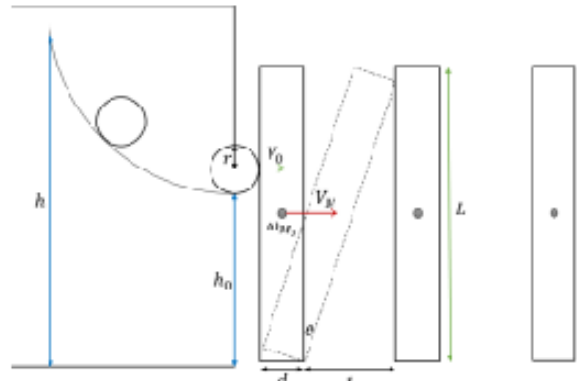
小論文中的應用

閃退的骨牌



實驗操作影片

圖一：鋼珠撞擊第一塊骨牌的示意圖



Tracker實際操作圖

The screenshot displays the Tracker software interface. The main window shows a video of a blue object on a grid. The interface includes a menu bar, a toolbar, and a 'Track 控制項' (Track Controls) window. The '質量 A' (Mass A) window shows a mass of 8.361 g. The '繪圖' (Graph) window displays two graphs: '質量 A (t, x)' and '質量 A (t, y)'. The '表格資料' (Table Data) window shows a table of motion data for '質量 A'.

質量 A (t, x)

t (s)	x (cm)
0.02	0.0
0.04	0.2
0.06	0.4
0.08	0.6
0.10	0.8
0.12	1.0
0.14	1.2
0.16	1.4
0.18	1.6
0.20	1.8
0.22	2.0
0.24	2.2
0.26	2.4
0.28	2.6
0.30	2.8
0.32	3.0

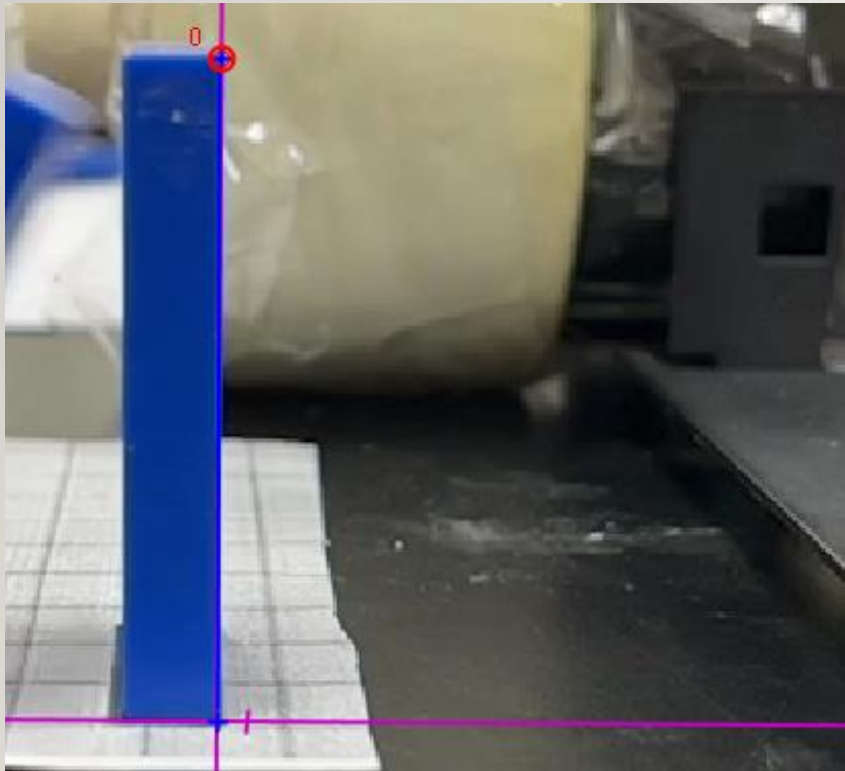
質量 A (t, y)

t (s)	y (cm)
0.02	4.5
0.04	4.4
0.06	4.3
0.08	4.2
0.10	4.1
0.12	4.0
0.14	3.9
0.16	3.8
0.18	3.7
0.20	3.6
0.22	3.5
0.24	3.4
0.26	3.3
0.28	3.2
0.30	3.1
0.32	3.0

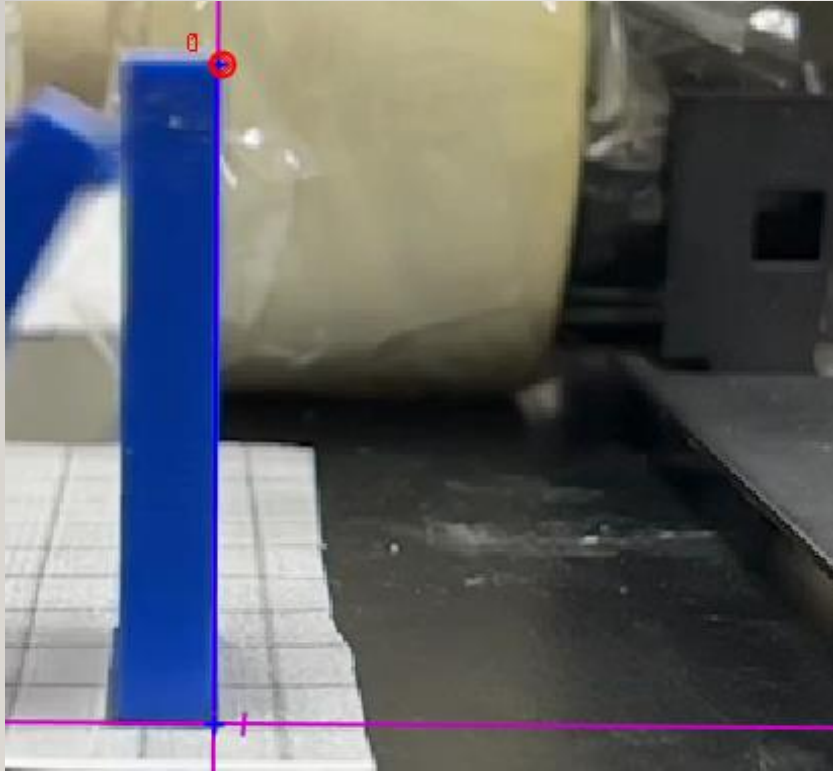
表格資料

t(s)	x(c)	y(c)	r(c)	θ	v _x	v _y	v(c)	a _x	a _y	a(c)	θ	ω	α	step	fra.	p.	d.	p(c)	θ	pixel	pixel	L	K		
0	2	4	4	61	24	-1	28	-3	10	-2	24	-6	61	-3	-2	5	522	20	-1	23	-2	58	19	2	3
0	1	4	4	73	21	-9	23	-2	40	-1	15	-7	73	-2	-1	4	521	18	-8	20	-2	54	17	1	2
0	1	4	4	76	18	-4	18	-1	11	-1	17	-4	76	-2	-1	3	520	15	-3	15	-1	52	16	1	1
0	3	3	4	49	21	-1	29	-4	-9	-1	14	-1	49	-3	12	5	523	17	-1	24	-3	61	22	3	3
0	0	4	4	88	16	-2	16	7	30	-3	31	-1	88	-1		2	519	13	-1	13	-6	48	16	0	1
0	3	2	4	37	17	-2	26	-5	-2	14	25	14	37	-3	31	7	524	14	-1	23	-4	64	25	4	3
0	4	2	4	26	8	-1	14	-5	-1	17	22	13	26	-1	28	8	525	8	-9	12	-4	67	29	5	86
0	6	4	4	89	5	0	5	4	1				89			1	518	42	3	42	34	47	16	0	10
0	4	2	4	26	-3	1	3	15					26	0	4	9	526	-0	0	0	12	67	29	5	6
0	4	2	4	26									26			10	527					67	29	5	

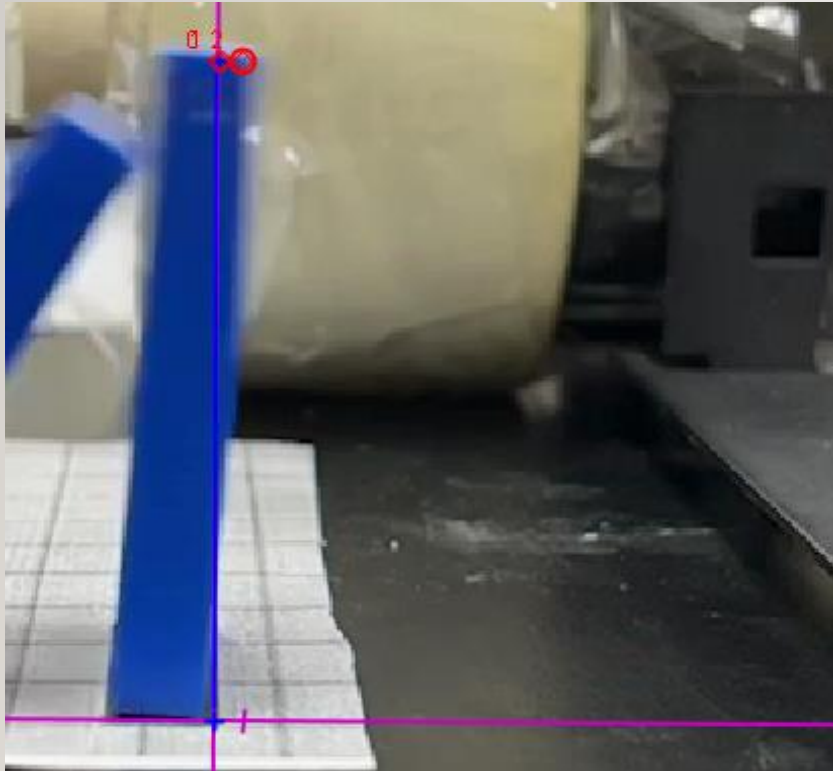
軌跡追従



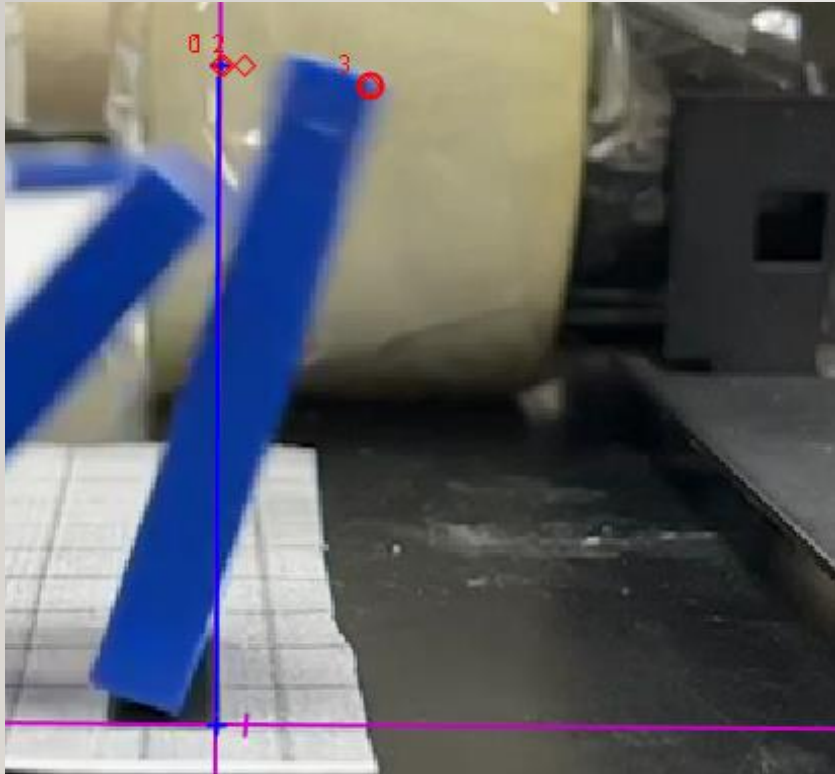
軌跡追跡



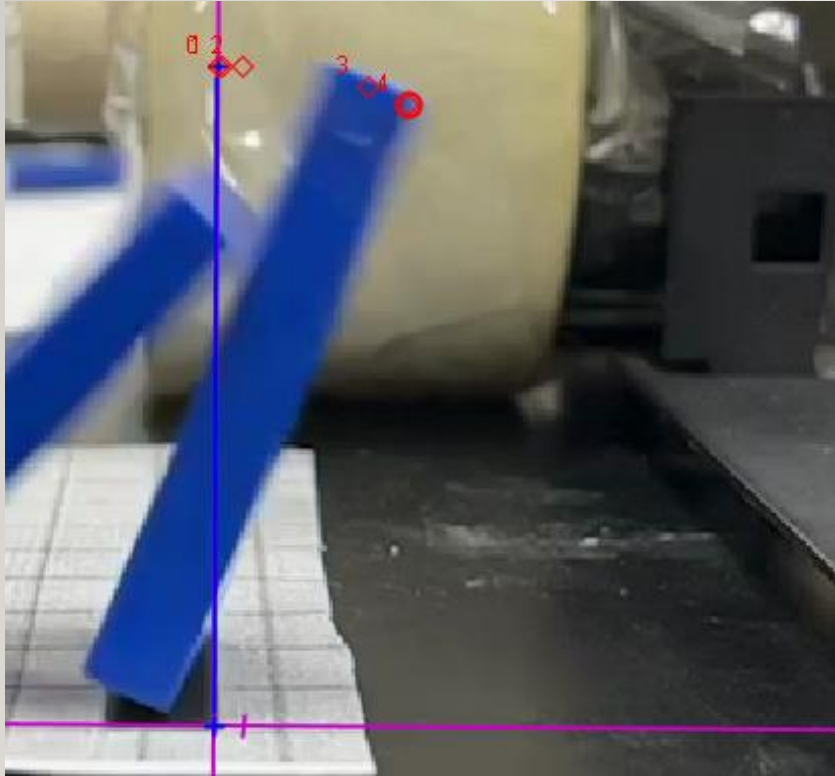
軌跡追従



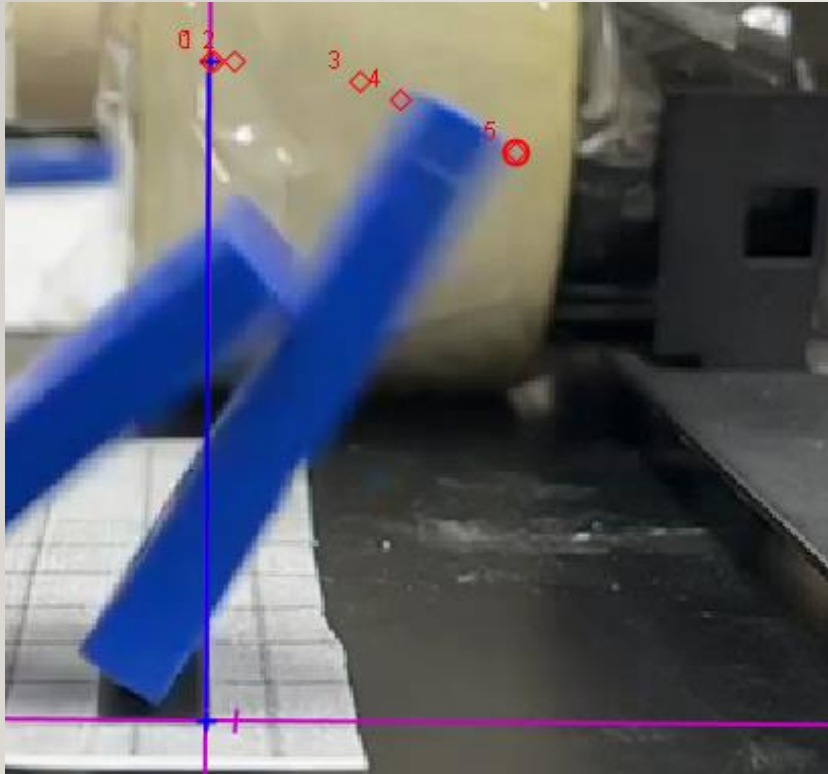
軌跡追跡



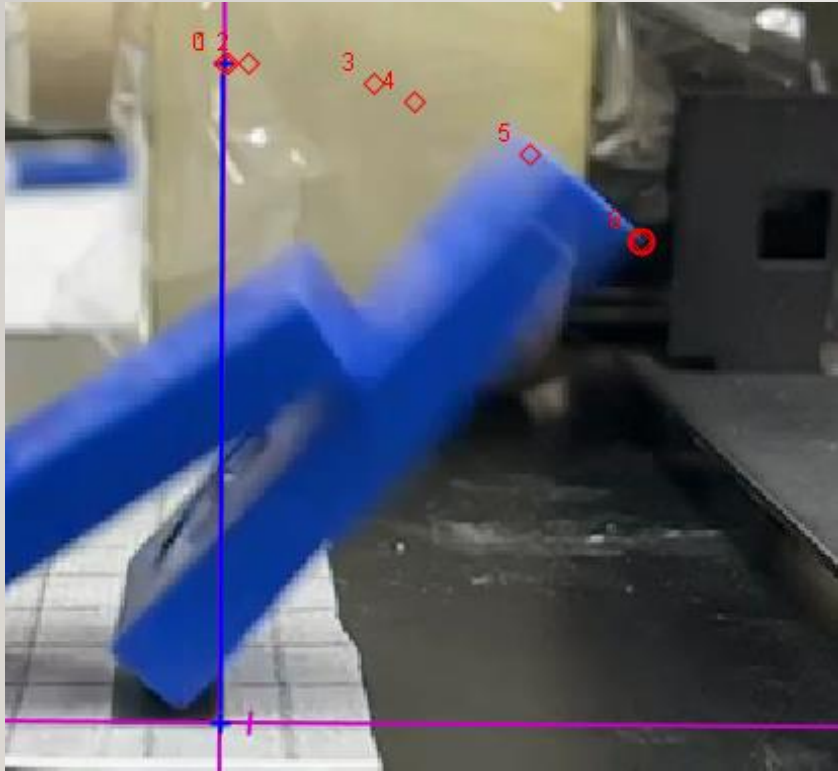
軌跡追跡



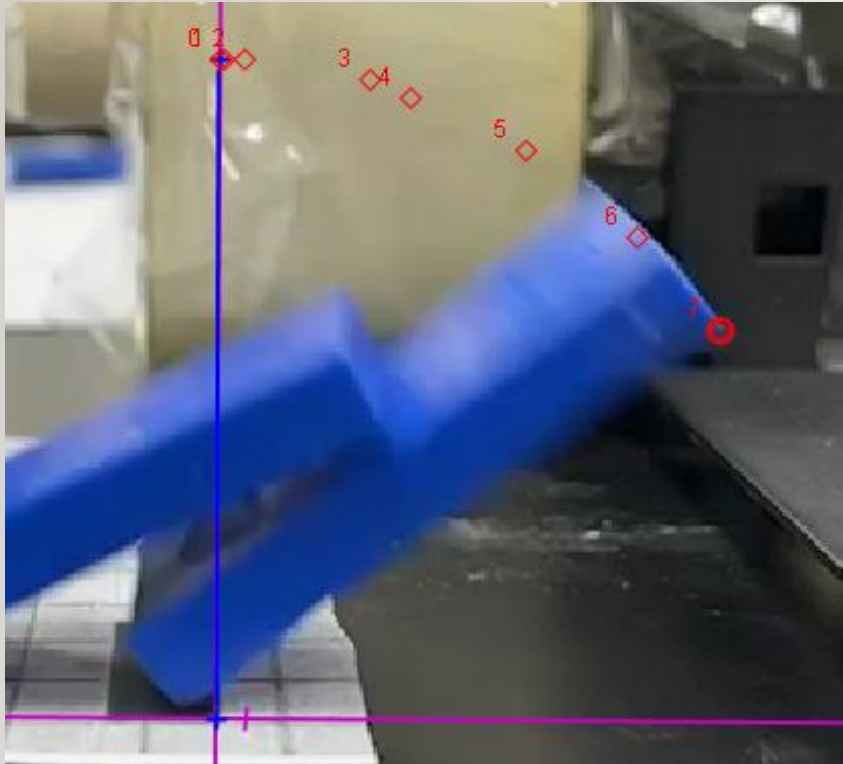
軌跡追従



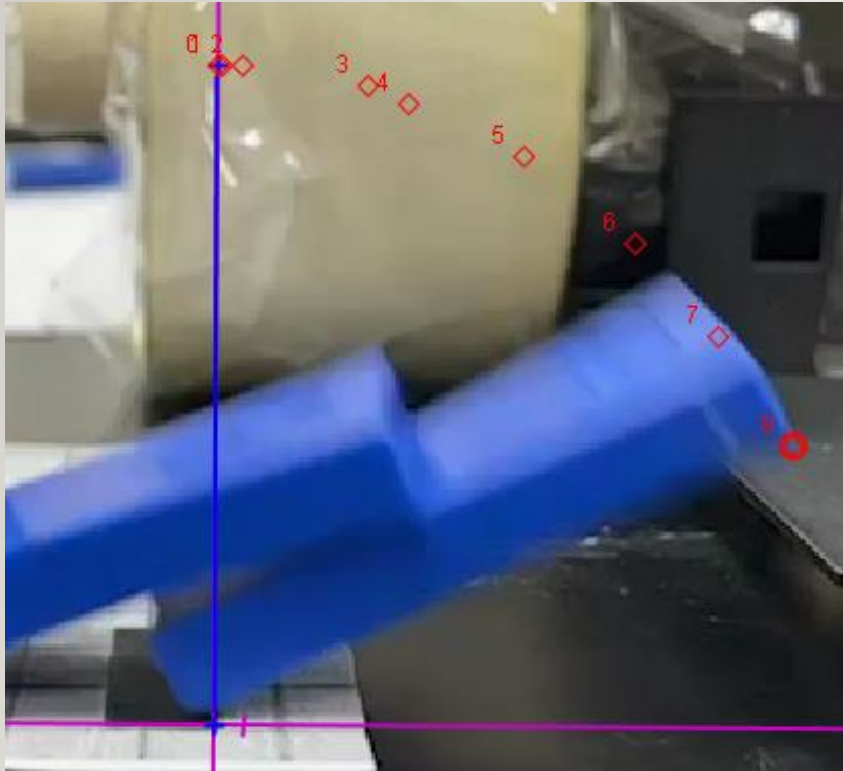
軌跡追従



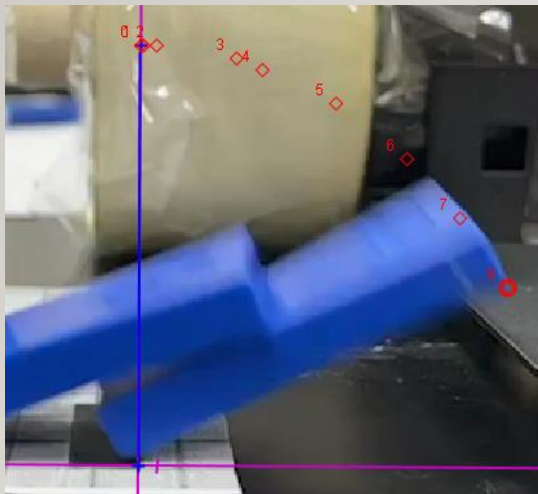
軌跡追跡



軌跡追従

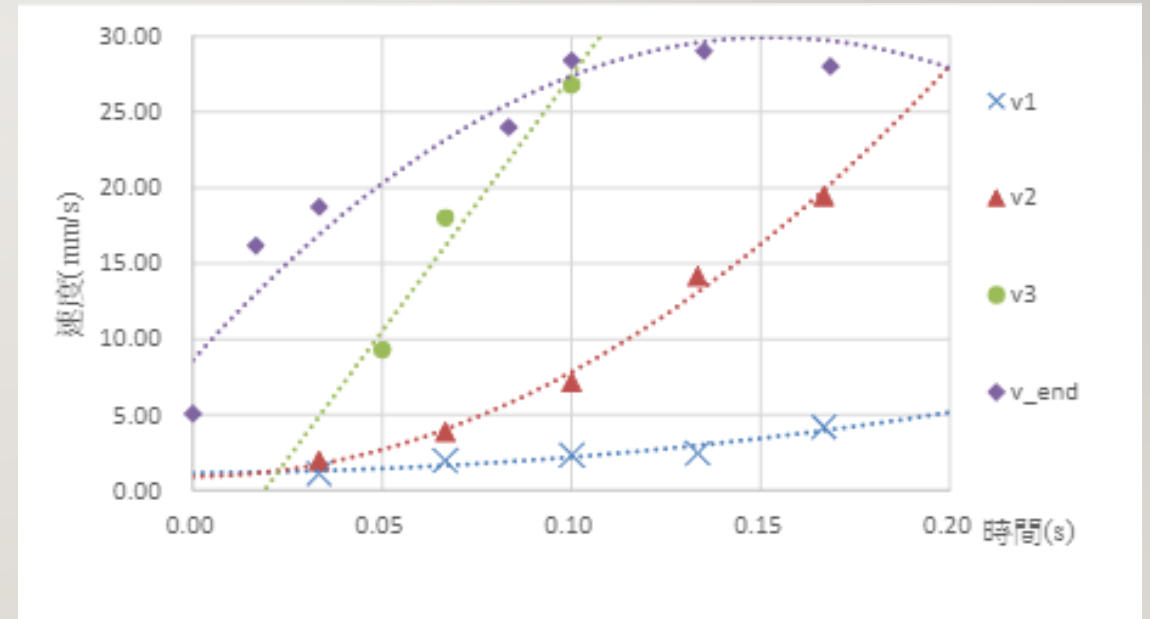
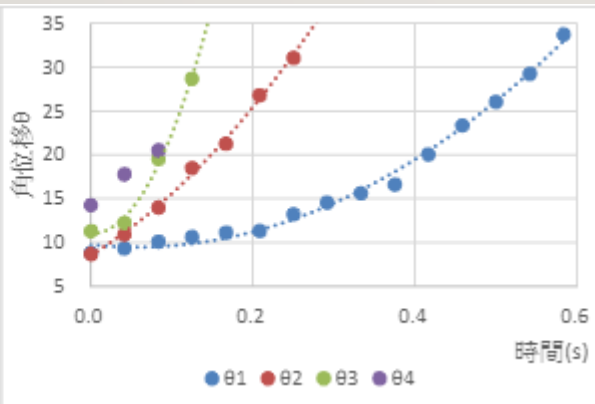
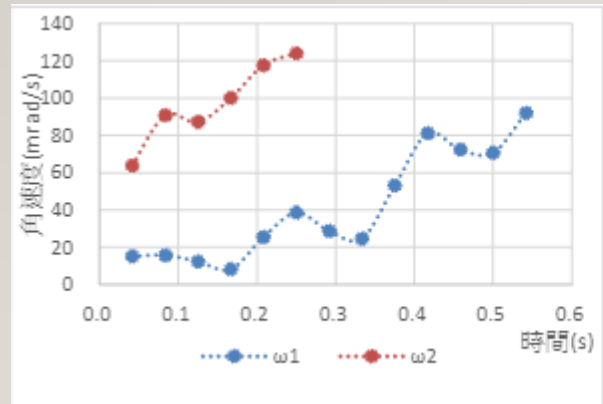
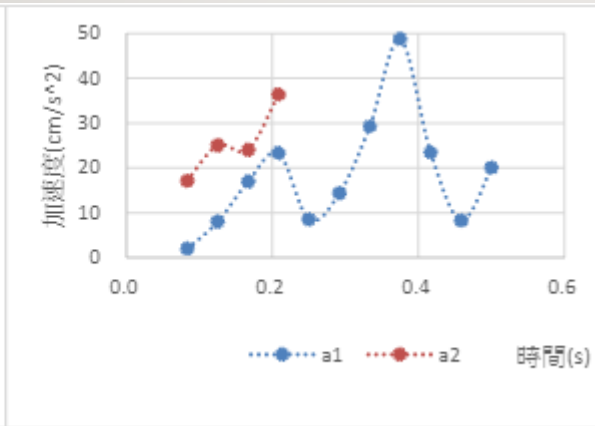
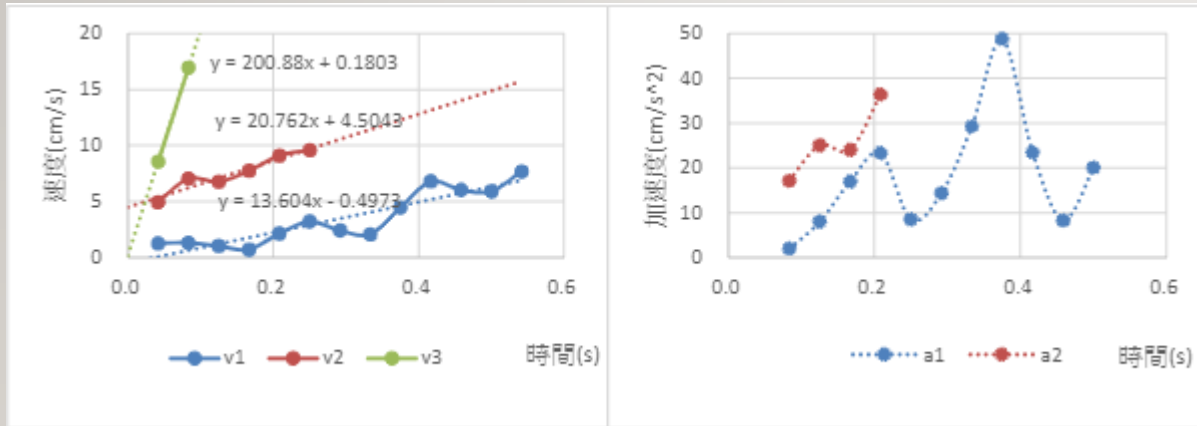


Tracker分析出的資料



t(s)	x(cm)	y(cm)	r(cm)	θ_r	v_x	v_y	v(c...)	θ_v	a_x	a_y	a(c...)	θ_a	θ	ω (°/s)	α (°/...)	step	frame	p_x	p_y	p(g...)	θ_p	pixel _x	pixel _y	L(cm)	K(g...)
0.000	-5.2...	4.792	4.792	90.0°									90.0°			0	517					474.1	161.7	0.000	
0.017	2.26...	4.794	4.794	89.7°	5.037	0.365	5.050	4.1°					89.7°	-60.0		1	518	42.11	3.049	42.22	34.6°	475.2	161.6	2.33...	106.6
0.033	0.167	4.804	4.807	88.0°	16.03	-2.1...	16.17	-7.6°	301.9	-91...	315.6	-16.9°	88.0°	-194...	-377...	2	519	134.0	-17...	135.2	-63.1°	482.2	161.2	0.168	1.09...
0.083	1.091	4.653	4.779	76.8°	18.27	-4.0...	18.71	-12.5°	122.9	-124...	175.2	-45.4°	76.8°	-224...	-188...	3	520	152.8	-33...	156.4	-104...	526.5	168.8	1.105	1.46...
0.100	1.385	4.535	4.742	73.0°	21.87	-9.8...	23.98	-24.2°	40.54	-153...	159.2	-75.2°	73.0°	-290...	-128...	4	521	182.9	-82...	200.5	-202...	540.6	174.5	1.421	2.40...
0.135	2.222	4.146	4.703	61.8°	24.16	-14...	28.39	-31.7°	102.7	-219...	242.0	-64.9°	61.8°	-348...	-267...	5	522	202.0	-124...	237.3	-264...	580.6	193.5	2.344	3.36...
0.168	3.036	3.516	4.646	49.2°	21.51	-19...	29.01	-42.2°	-97...	-105...	143.2	-132...	49.2°	-358...	12.5	6	523	179.8	-162...	242.6	-352...	619.5	224.0	3.373	3.51...
0.202	3.655	2.847	4.634	37.9°	17.49	-21...	28.01	-51.4°	-111...	-84...	140.1	-142...	37.9°	-346...	90.5	7	524	146.2	-182...	234.2	-429...	649.1	256.3	4.285	3.27...
0.235	4.202	2.058	4.679	26.1°	14.45	-25...	29.14	-60.3°					26.1°	-357...		8	525	120.8	-211...	243.7	-504...	675.0	294.4	5.245	3.55...
0.268	4.619	1.160	4.762	14.1°									14.1°			9	526					694.8	337.7	6.235	

運用Tracker分析出來的資料所繪製的圖表



小論文研究心得

在使用Tracker時，由於先前完全沒接觸過，需要到網路上找資料，其中又因為找到的資料版本並非最新，以致於有些部分的操作方法要自己摸索，整個操作過程中，最困難的部分是追蹤每一幀畫面中質心的位置，由於網路上的操作說明都是使用「自動追蹤器」，但我的影片和追蹤的物體不符和「自動追蹤器」的使用條件，不過我在Tracker中摸索了許久後，找到了手動追蹤的方法，解決了這個問題。

The End
