

Optimal Exposure Time

This module provides two tables to facilitate the determination of an optimal exposure time for the detection of moving objects.

The first table is a listing of different exposure times. The second table is a listing of different dwell times (DT).

The First Table

Column 1 of the first table identifies the exposure time, in seconds.

Column 2 in the first table identifies the speed of an object that would produce a streak of 1 pixel SPD(1).

Column 3 in the first table identifies the speed of an object that would produce a streak of 2 pixels SPD(2).

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Column 7 in the first table identifies the dwell time that will occur after having captured 11 frames of the given exposure time DT(11).

Column 8 in the first table identifies the dwell time that will occur after having captured 25 frames of the given exposure time DT(25).

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The last column in the first table identifies the dwell time that will occur after having captured 480 frames of the given exposure time DT(480).

The second table

Column 1 of the second table identifies the dwell time, in seconds.

Column 2 of the second table identifies the speed of an object that will travel 5 pixels in the given dwell time, SPD(5).

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The last column of the second table identifies the speed of an object that will travel 4000 pixels in the given dwell time, SPD(4000).

Instructions

Specify the plate scale of your system, in arcseconds per pixel ($''/\text{pixel}$). Then click the "Refresh" button. Both tables will be recomputed with the new plate scale.

You can use the information in the tables to determine an optimal exposure time for the synthetic tracker. For example, the default upper limit for speed corresponds to 4 pixels of streak. Knowing this, if you had a plate scale of $1.65''/\text{pixel}$ and wanted the tracker to have an upper limit of around $10''/\text{min}$, you would look in the first table and see that an exposure time of 40.00 seconds has a SPD(4) value of $9.90''/\text{min}$ – meaning that an object traveling $9.90''/\text{min}$ will produce 4 pixels of streak which is the default upper limit for the tracker.

Another example is to determine the shortest dwell time that can still detect a (relatively) slow object. Suppose that you wanted to detect a lower-bound of $0.4''/\text{min}$. Using the second table, you see that a

dwell time of 1200.0 seconds (20 minutes) corresponds to a SPD(5) of 0.412"/min – meaning that an object traveling at 0.412"/min will travel 5 pixels in 20 minutes at the plate scale of 1.65"/pixel. The 5 pixels are the minimum travel required for the object to be ideally detected by the tracker.

Example:

Calculator: Optimal Exposure Time

Exp(s)	SPD(1)	SPD(2)	SPD(4)	SPD(8)	SPD(16)	DT(11)	DT(25)	DT(60)	DT(120)	DT(240)	DT(480)
13.00	5.77	11.54	23.08	46.15	92.31	143.00	325.00	780.00	1560.00	3120.00	6240.00
14.00	5.36	10.71	21.43	42.86	85.71	154.00	350.00	840.00	1680.00	3360.00	6720.00
15.00	5.00	10.00	20.00	40.00	80.00	165.00	375.00	900.00	1800.00	3600.00	7200.00
16.00	4.69	9.38	18.75	37.50	75.00	176.00	400.00	960.00	1920.00	3840.00	7680.00
17.00	4.41	8.82	17.65	35.29	70.59	187.00	425.00	1020.00	2040.00	4080.00	8160.00
18.00	4.17	8.33	16.67	33.33	66.67	198.00	450.00	1080.00	2160.00	4320.00	8640.00
19.00	3.95	7.89	15.79	31.58	63.16	209.00	475.00	1140.00	2280.00	4560.00	9120.00
20.00	3.75	7.50	15.00	30.00	60.00	220.00	500.00	1200.00	2400.00	4800.00	9600.00
21.00	3.57	7.14	14.29	28.57	57.14	231.00	525.00	1260.00	2520.00	5040.00	10080.00
22.00	3.41	6.82	13.64	27.27	54.55	242.00	550.00	1320.00	2640.00	5280.00	10560.00
23.00	3.26	6.52	13.04	26.09	52.17	253.00	575.00	1380.00	2760.00	5520.00	11040.00
24.00	3.13	6.25	12.50	25.00	50.00	264.00	600.00	1440.00	2880.00	5760.00	11520.00
25.00	3.00	6.00	12.00	24.00	48.00	275.00	625.00	1500.00	3000.00	6000.00	12000.00
26.00	2.88	5.77	11.54	23.08	46.15	286.00	650.00	1560.00	3120.00	6240.00	12480.00
27.00	2.78	5.56	11.11	22.22	44.44	297.00	675.00	1620.00	3240.00	6480.00	12960.00
28.00	2.68	5.36	10.71	21.43	42.86	308.00	700.00	1680.00	3360.00	6720.00	13440.00
29.00	2.59	5.17	10.34	20.69	41.38	319.00	725.00	1740.00	3480.00	6960.00	13920.00
30.00	2.50	5.00	10.00	20.00	40.00	330.00	750.00	1800.00	3600.00	7200.00	14400.00

DT(s)	SPD(5)	SPD(10)	SPD(20)	SPD(40)	SPD(80)	SPD(125)	SPD(250)	SPD(500)	SPD(1000)	SPD(2000)	SPD(4000)
1.0	375.000	750.000	1500.000	3000.000	6000.000	9375.000	18750.000	37500.000	75000.000	150000.000	300000.000
5.0	75.000	150.000	300.000	600.000	1200.000	1875.000	3750.000	7500.000	15000.000	30000.000	60000.000
10.0	37.500	75.000	150.000	300.000	600.000	937.500	1875.000	3750.000	7500.000	15000.000	30000.000
20.0	18.750	37.500	75.000	150.000	300.000	468.750	937.500	1875.000	3750.000	7500.000	15000.000
30.0	12.500	25.000	50.000	100.000	200.000	312.500	625.000	1250.000	2500.000	5000.000	10000.000
60.0	6.250	12.500	25.000	50.000	100.000	156.250	312.500	625.000	1250.000	2500.000	5000.000
90.0	4.167	8.333	16.667	33.333	66.667	104.167	208.333	416.667	833.333	1666.667	3333.333
120.0	3.125	6.250	12.500	25.000	50.000	78.125	156.250	312.500	625.000	1250.000	2500.000
180.0	2.083	4.167	8.333	16.667	33.333	52.083	104.167	208.333	416.667	833.333	1666.667
240.0	1.562	3.125	6.250	12.500	25.000	39.062	78.125	156.250	312.500	625.000	1250.000

Plate scale (arcsec/pixel): 1.250 Refresh Help... Object speed (arcsec/minute): 4.500 Show Optimal Exp Time Cancel OK

Given a plate scale of 1.25 arcseconds per pixel ("/px) and an object speed of 4.5 arcseconds per minute ("/min), we want to determine the optimal exposure time.

- Step 1: Specify "1.25" for the plate scale
- Step 2: Specify "4.5" for the object speed
- Step 3: Click the button labeled "Show Optimal Exp Time"

After performing the above, you will see that the exposure time of 17.00 seconds is highlighted. The SPD(1) column shows that an object of speed 4.41"/min would produce 1 pixel of streak with the given plate scale.