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THEME

P. 1

(a) $s = 0.5$

$$R = \begin{bmatrix} \cos 30^\circ & -\sin 30^\circ \\ \sin 30^\circ & \cos 30^\circ \end{bmatrix} = \begin{bmatrix} \frac{\sqrt{3}}{2} & -\frac{1}{2} \\ \frac{1}{2} & \frac{\sqrt{3}}{2} \end{bmatrix}$$

$$t = \begin{bmatrix} 2 \\ 2 \end{bmatrix}$$

(b)

$$sR = \begin{bmatrix} \frac{\sqrt{3}}{4} & \frac{-1}{4} & 0 \\ \frac{1}{4} & \frac{\sqrt{3}}{4} & 0 \\ 0 & 0 & 1 \end{bmatrix} \qquad t = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix}$$

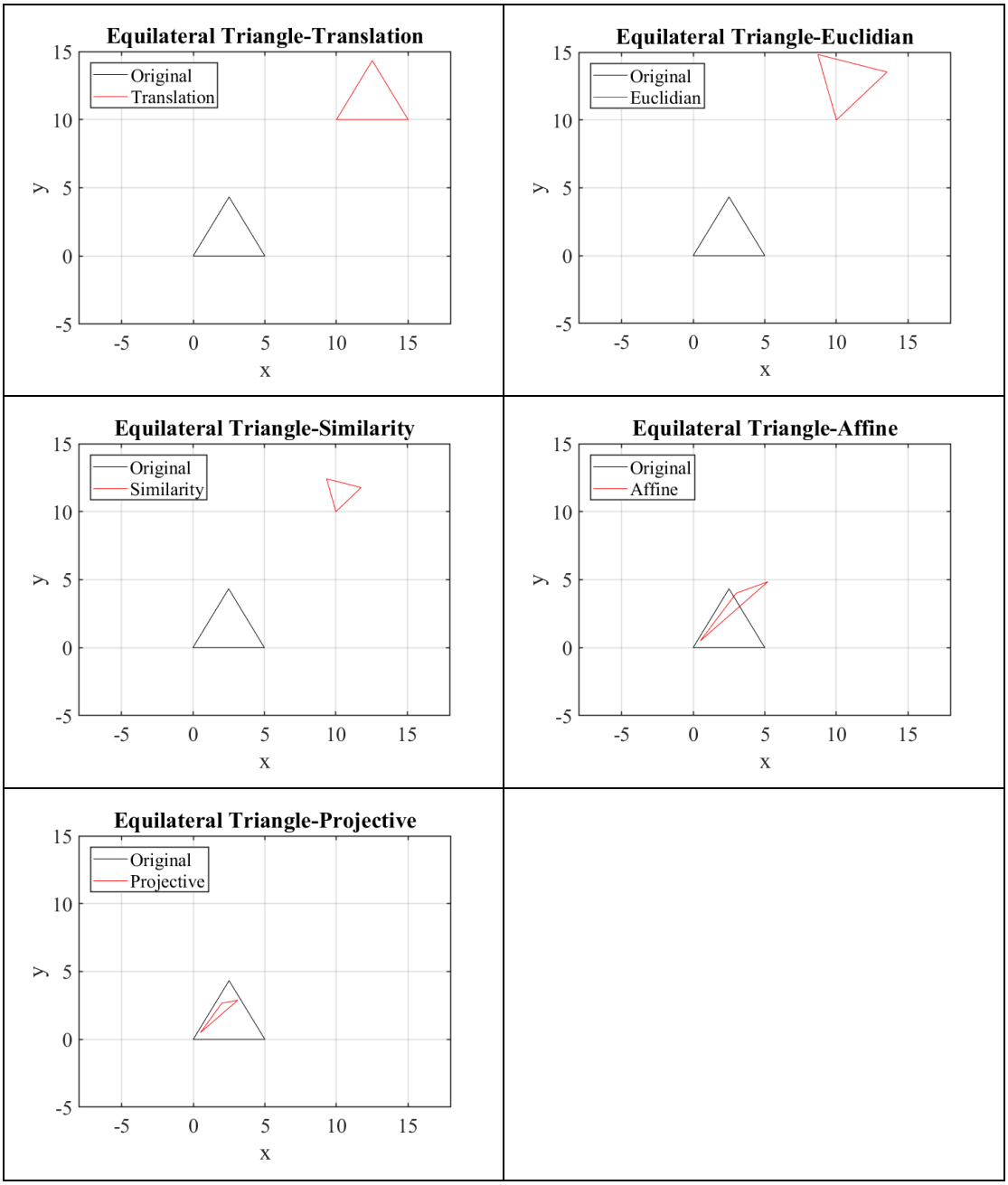
$$\tilde{X}' = \begin{bmatrix} 1 & 0 & 2 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \frac{\sqrt{3}}{4} & \frac{-1}{4} & 0 \\ \frac{1}{4} & \frac{\sqrt{3}}{4} & 0 \\ 0 & 0 & 1 \end{bmatrix} \hat{X}$$

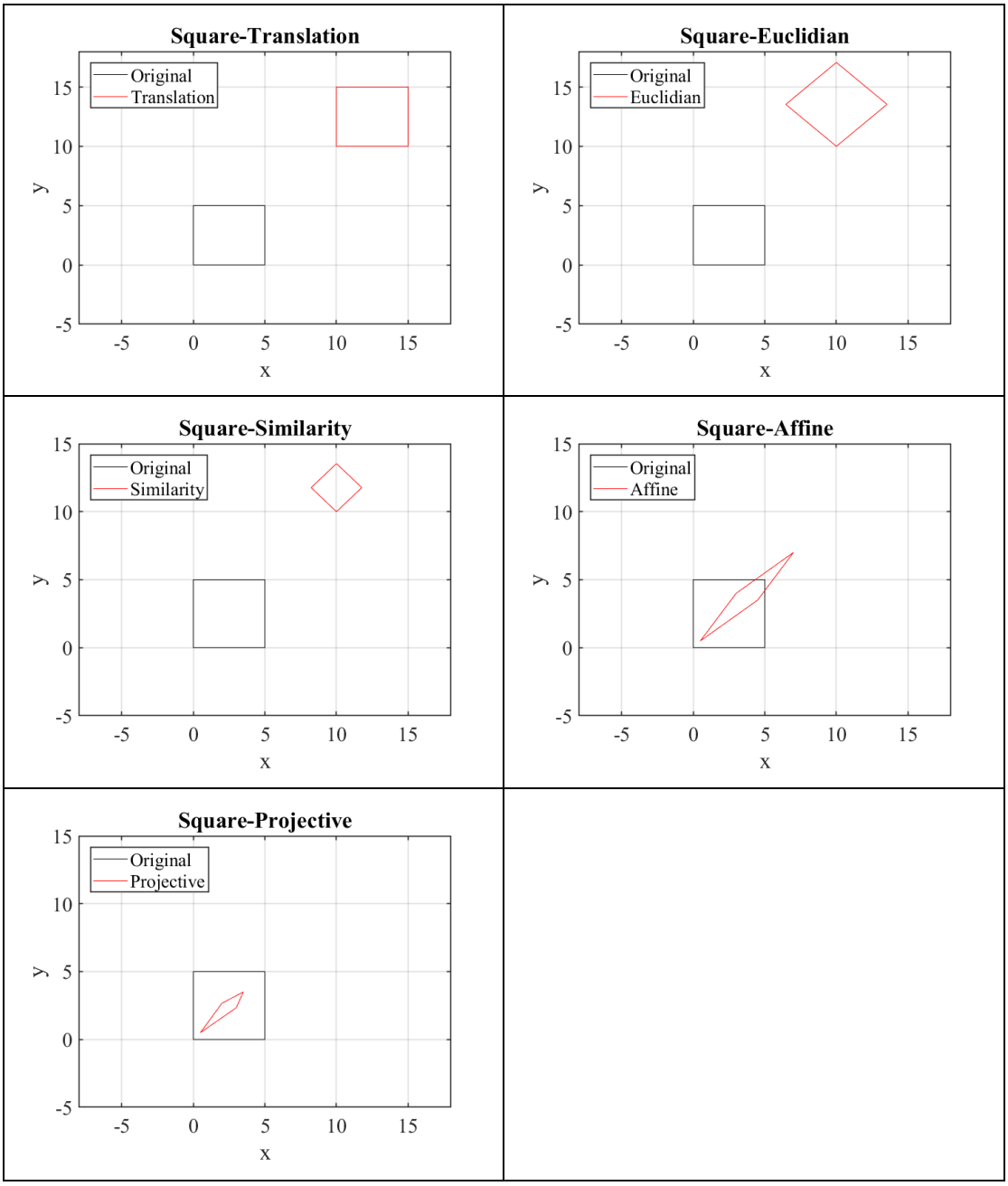
$$= \begin{bmatrix} \frac{\sqrt{3}}{4} & \frac{-1}{4} & 2 \\ \frac{1}{4} & \frac{\sqrt{3}}{4} & 2 \\ 0 & 0 & 1 \end{bmatrix} \tilde{X}$$

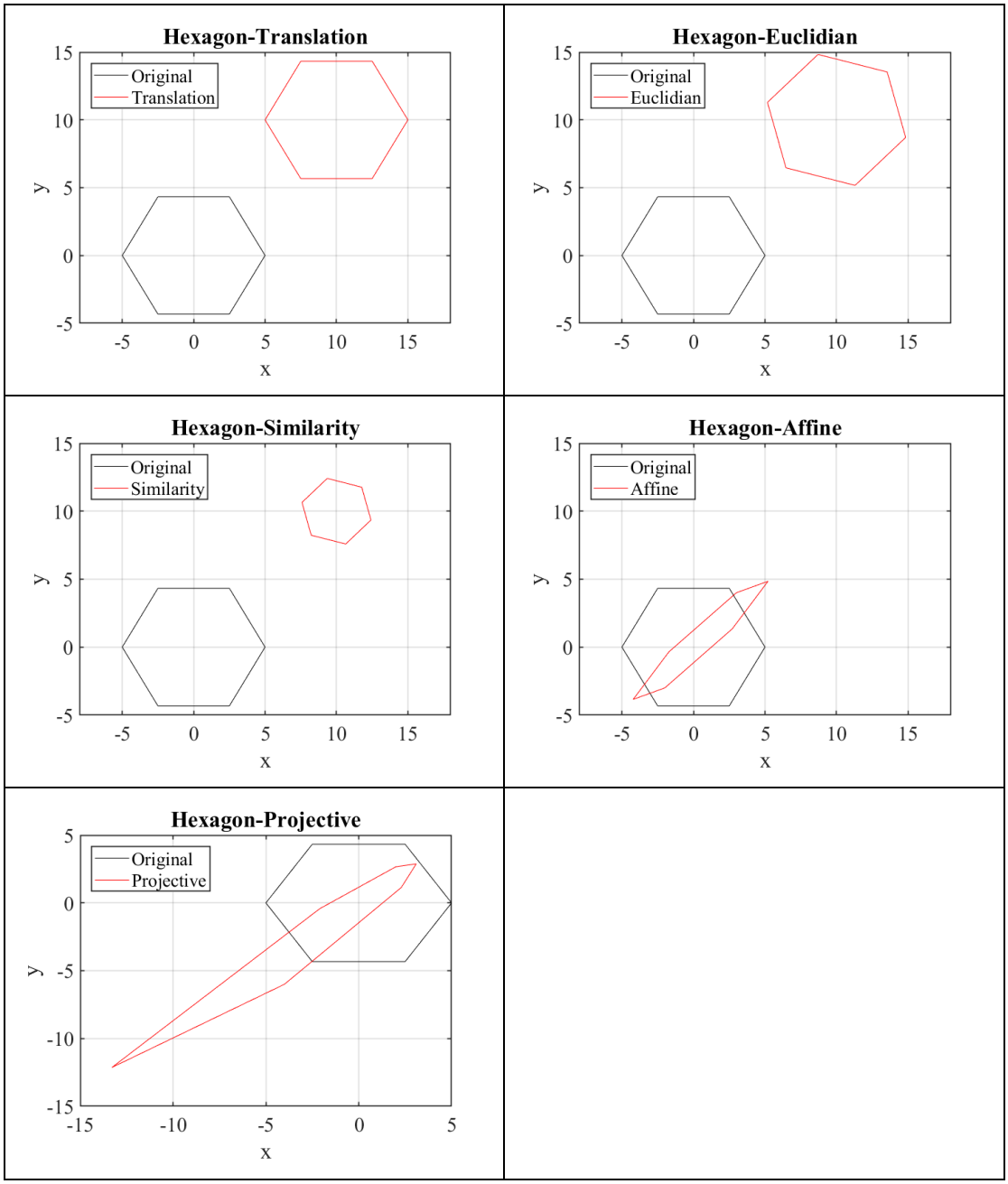
$$\rightarrow \begin{bmatrix} \frac{\sqrt{3}}{4} & \frac{-1}{4} & 2 \\ \frac{1}{4} & \frac{\sqrt{3}}{4} & 2 \\ 0 & 0 & 1 \end{bmatrix} \#$$

Problem2

(a)


Equilateral Triangle-Translation
Original
Translation
Equilateral Triangle-Euclidian
Original
Euclidian
Equilateral Triangle-Similarity
Original
Similarity
Equilateral Triangle-Affine
Original
Affine
Equilateral Triangle-Projective
Original
Projective
x
y


Square-Translation
Original
Translation
Square-Euclidian
Original
Euclidian
Square-Similarity
Original
Similarity
Square-Affine
Original
Affine
Square-Projective
Original
Projective
x
y



(b)

	Preserve
Translation	Orientation
Euclidian	Lengths
Similarity	Angles
Affine	Parallelism
Projective	Straight line

(c)

Translation	

	1	2	3
1	1	0	10
2	0	1	10
3	0	0	1

Euclidian	

	1	2	3
1	0.7071	-0.7071	10
2	0.7071	0.7071	10
3	0	0	1

Similarity	

	1	2	3
1	0.3536	-0.3536	10
2	0.3536	0.3536	10
3	0	0	1

Affine	

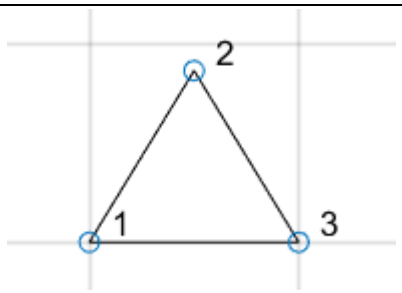
	1	2	3
1	0.5000	0.8000	0.5000
2	0.7000	0.6000	0.5000
3	0	0	1

Projective	

	1	2	3
1	0.5000	0.8000	0.5000
2	0.7000	0.6000	0.5000
3	0.1000	0.1000	1

(d)

Triangle (Homogeneous coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \\ w_1 & w_2 & w_3 \end{bmatrix}$$

Original

	1	2	3
1	0	2.5000	5
2	0	4.3301	0
3	1	1	1

Translation

	1	2	3
1	10	12.5000	15
2	10	14.3301	10
3	1	1	1

Euclidian

	1	2	3
1	10	8.7059	13.5355
2	10	14.8296	13.5355
3	1	1	1

Similarity

	1	2	3
1	10	9.3530	11.7678
2	10	12.4148	11.7678
3	1	1	1

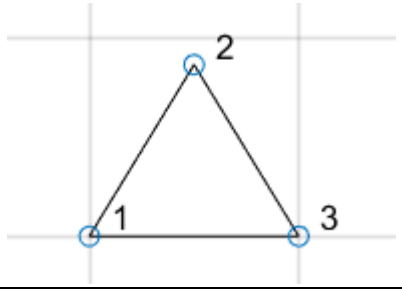
Affine

	1	2	3
1	0.5000	5.2141	3
2	0.5000	4.8481	4
3	1	1	1

Projective

	1	2	3
1	0.5000	5.2141	3
2	0.5000	4.8481	4
3	1	1.6830	1.5000

Triangle (Cartesian coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 \\ y_1 & y_2 & y_3 \end{bmatrix}$$

Original

	1	2	3
1	0	2.5000	5
2	0	4.3301	0

Translation

	1	2	3
1	10	12.5000	15
2	10	14.3301	10

Euclidian

	1	2	3
1	10	8.7059	13.5355
2	10	14.8296	13.5355

Similarity

	1	2	3
1	10	9.3530	11.7678
2	10	12.4148	11.7678

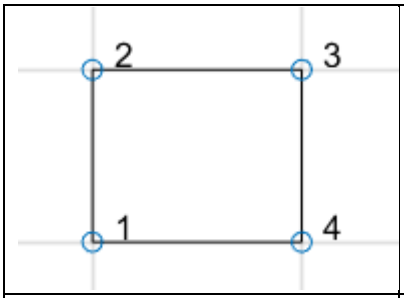
Affine

	1	2	3
1	0.5000	5.2141	3
2	0.5000	4.8481	4

Projective

	1	2	3
1	0.5000	3.0981	2
2	0.5000	2.8806	2.6667

Square (Homogeneous coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \\ w_1 & w_2 & w_3 & w_4 \end{bmatrix}$$

Original

	1	2	3	4
1	0	0	5	
2	0	5	5	
3	1	1	1	

Translation

	1	2	3	4
1	10	10	15	15
2	10	15	15	10
3	1	1	1	1

Euclidian

	1	2	3	4
1	10	6.4645	10	13.5355
2	10	13.5355	17.0711	13.5355
3	1	1	1	1

Similarity

	1	2	3	4
1	10	8.2322	10	11.7678
2	10	11.7678	13.5355	11.7678
3	1	1	1	1

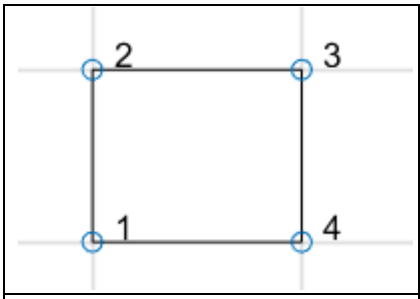
Affine

	1	2	3	4
1	0.5000	4.5000	7	3
2	0.5000	3.5000	7	4
3	1	1	1	1

Projective

	1	2	3	4
1	0.5000	4.5000	7	3
2	0.5000	3.5000	7	4
3	1	1.5000	2	1.5000

Square (Cartesian coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \end{bmatrix}$$

Original

	1	2	3	4
1	0	0	5	5
2	0	5	5	0

Translation

	1	2	3	4
1	10	10	15	15
2	10	15	15	10

Euclidian

	1	2	3	4
1	10	6.4645	10	13.5355
2	10	13.5355	17.0711	13.5355

Similarity

	1	2	3	4
1	10	8.2322	10	11.7678
2	10	11.7678	13.5355	11.7678

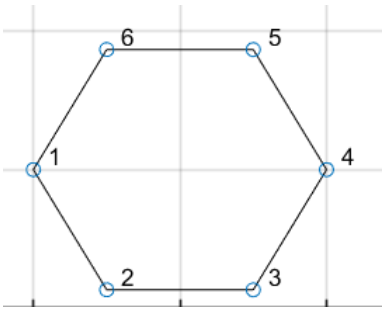
Affine

	1	2	3	4
1	0.5000	4.5000	7	3
2	0.5000	3.5000	7	4

Projective

	1	2	3	4
1	0.5000	3	3.5000	2
2	0.5000	2.3333	3.5000	2.6667

Hexagon (Homogeneous coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ y_1 & y_2 & y_3 & y_4 & y_5 & y_6 \\ w_1 & w_2 & w_3 & w_4 & w_5 & w_6 \end{bmatrix}$$

Original

	1	2	3	4	5	6
1	-5	-2.5000	2.5000	5	2.5000	-2.5000
2	0	-4.3301	-4.3301	0	4.3301	4.3301
3	1	1	1	1	1	1

Translation

	1	2	3	4	5	6
1	5	7.5000	12.5000	15	12.5000	7.5000
2	10	5.6699	5.6699	10	14.3301	14.3301
3	1	1	1	1	1	1

Euclidian

	1	2	3	4	5	6
1	6.4645	11.2941	14.8296	13.5355	8.7059	5.1704
2	6.4645	5.1704	8.7059	13.5355	14.8296	11.2941
3	1	1	1	1	1	1

Similarity

	1	2	3	4	5	6
1	8.2322	10.6470	12.4148	11.7678	9.3530	7.5852
2	8.2322	7.5852	9.3530	11.7678	12.4148	10.6470
3	1	1	1	1	1	1

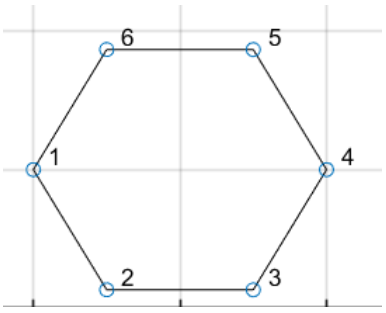
Affine

	1	2	3	4	5	6
1	-2	-4.2141	-1.7141	3	5.2141	2.7141
2	-3	-3.8481	-0.3481	4	4.8481	1.3481
3	1	1	1	1	1	1

Projective

	1	2	3	4	5	6
1	-2	-4.2141	-1.7141	3	5.2141	2.7141
2	-3	-3.8481	-0.3481	4	4.8481	1.3481
3	0.5000	0.3170	0.8170	1.5000	1.6830	1.1830

Hexagon (Cartesian coordinate)



$$\begin{bmatrix} x_1 & x_2 & x_3 & x_4 & x_5 & x_6 \\ y_1 & y_2 & y_3 & y_4 & y_5 & y_6 \end{bmatrix}$$

Original

	1	2	3	4	5	6
1	-5	-2.5000	2.5000	5	2.5000	-2.5000
2	0	-4.3301	-4.3301	0	4.3301	4.3301

Translation

	1	2	3	4	5	6
1	5	7.5000	12.5000	15	12.5000	7.5000
2	10	5.6699	5.6699	10	14.3301	14.3301

Euclidian

	1	2	3	4	5	6
1	6.4645	11.2941	14.8296	13.5355	8.7059	5.1704
2	6.4645	5.1704	8.7059	13.5355	14.8296	11.2941

Similarity

	1	2	3	4	5	6
1	8.2322	10.6470	12.4148	11.7678	9.3530	7.5852
2	8.2322	7.5852	9.3530	11.7678	12.4148	10.6470

Affine

	1	2	3	4	5	6
1	-2	-4.2141	-1.7141	3	5.2141	2.7141
2	-3	-3.8481	-0.3481	4	4.8481	1.3481

Projective

	1	2	3	4	5	6
1	-4	-13.2942	-2.0981	2	3.0981	2.2942
2	-6	-12.1395	-0.4260	2.6667	2.8806	1.1395