Background
(Linear Algebra, Jacobian Matrix)

- Linear Transformation / Affine Transformation
  Affine ~ = Linear ~ + shifting(translation, bias)

참고자료(kr)

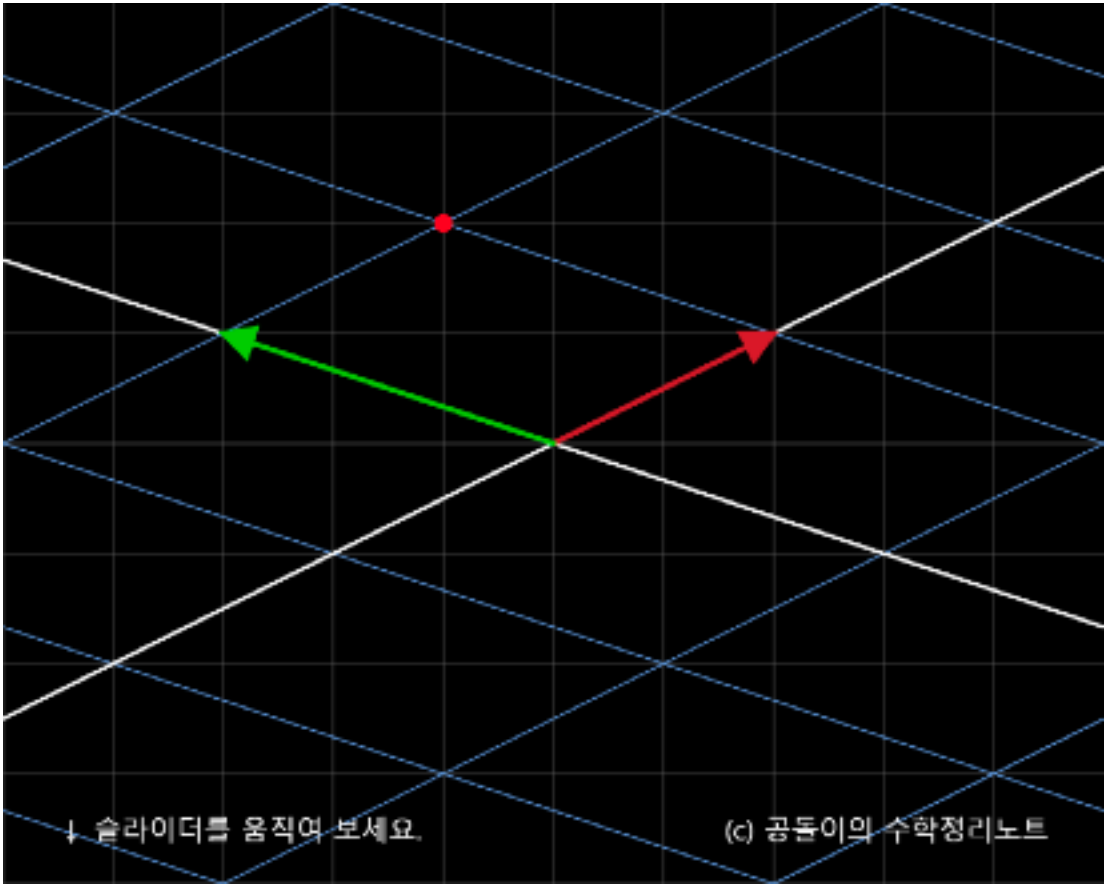
https://hooni-playground.com/1271/

https://angeloyeo.github.io/2019/07/15/Matrix_as_Linear_Transformation.html

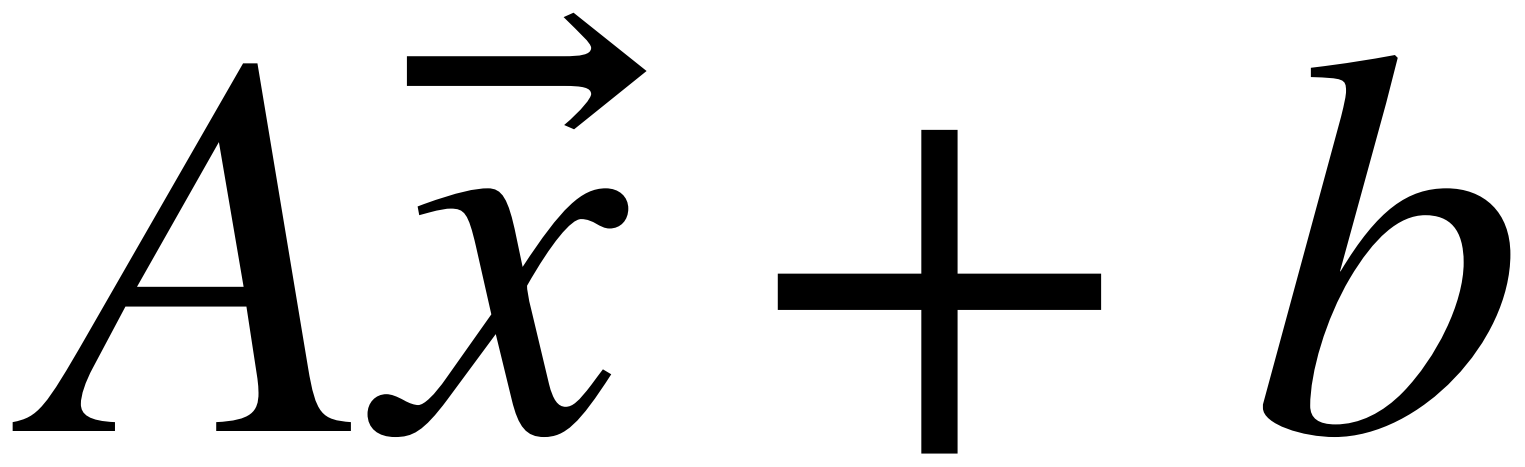
$$A = \begin{bmatrix} 2 & -3 \\ 1 & 1 \end{bmatrix}$$

$$\vec{x} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

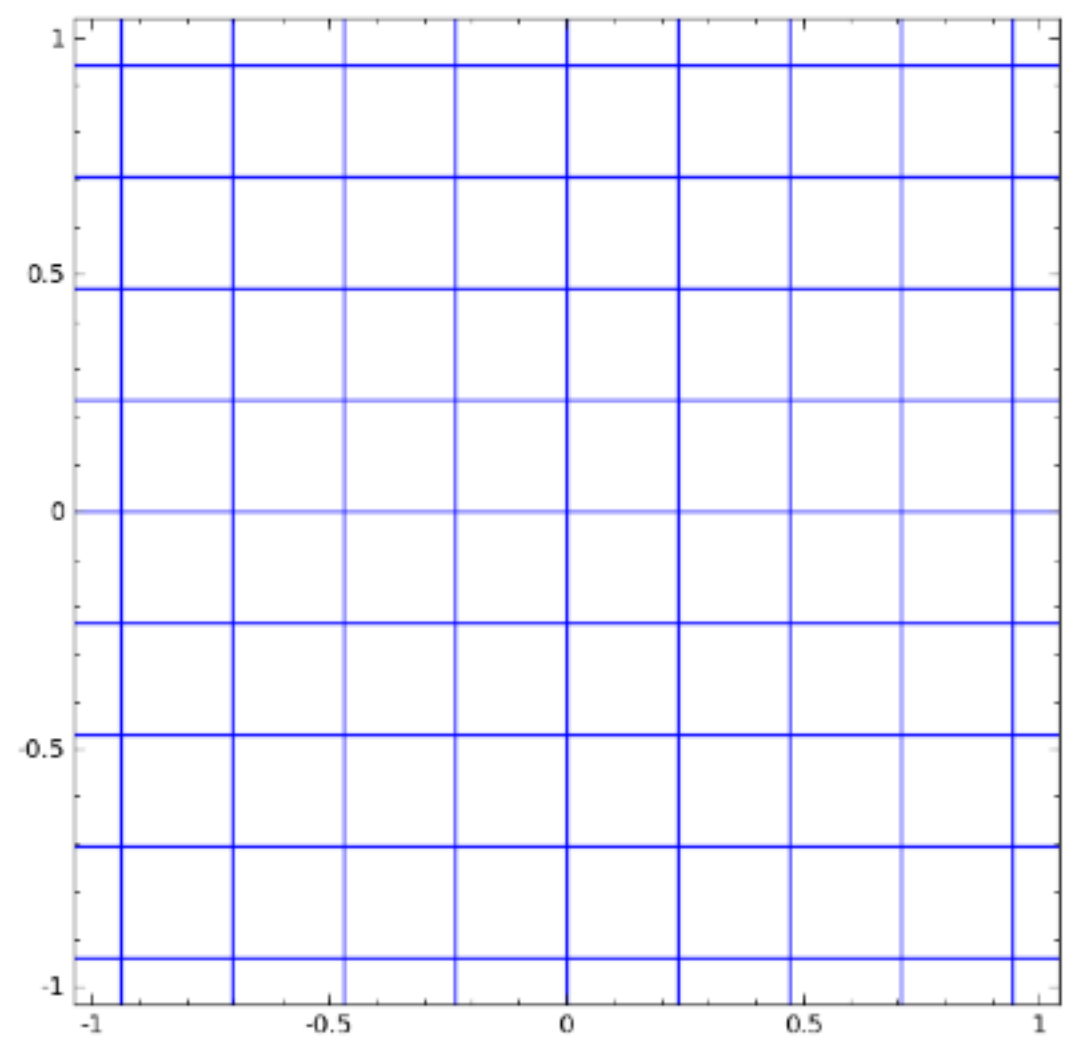
$$A\vec{x} = \begin{bmatrix} 2 & -3 \\ 1 & 1 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$$

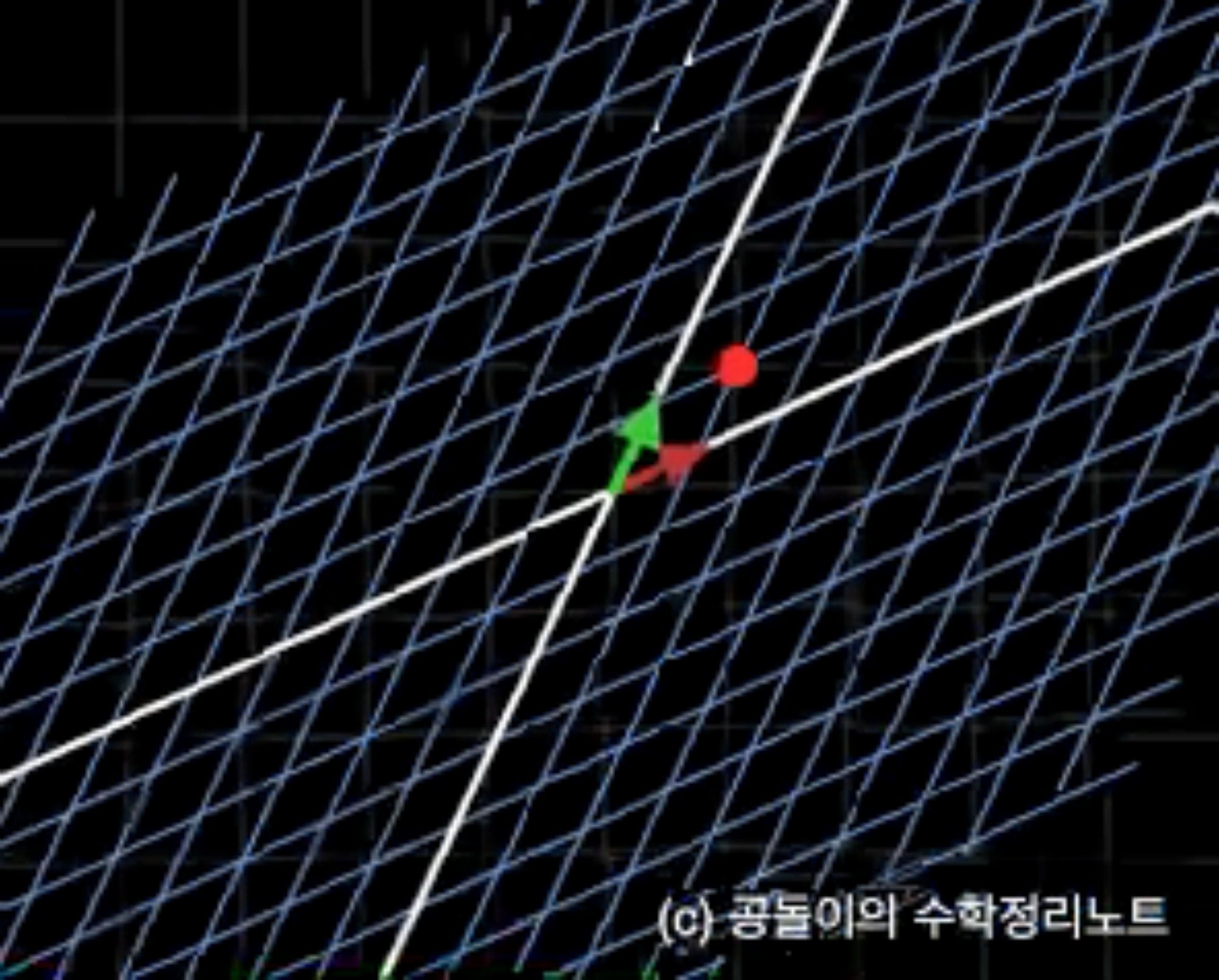

↓ 슬라이더를 움직여 보세요.
(c) 공돌이의 수학정리노트

* shearing
* rotation
* permutation
* projection on ~



(since it has offset, it is non-linear transformation)


1
0.5
0
-0.5
-1
-1
-0.5
0
0.5
1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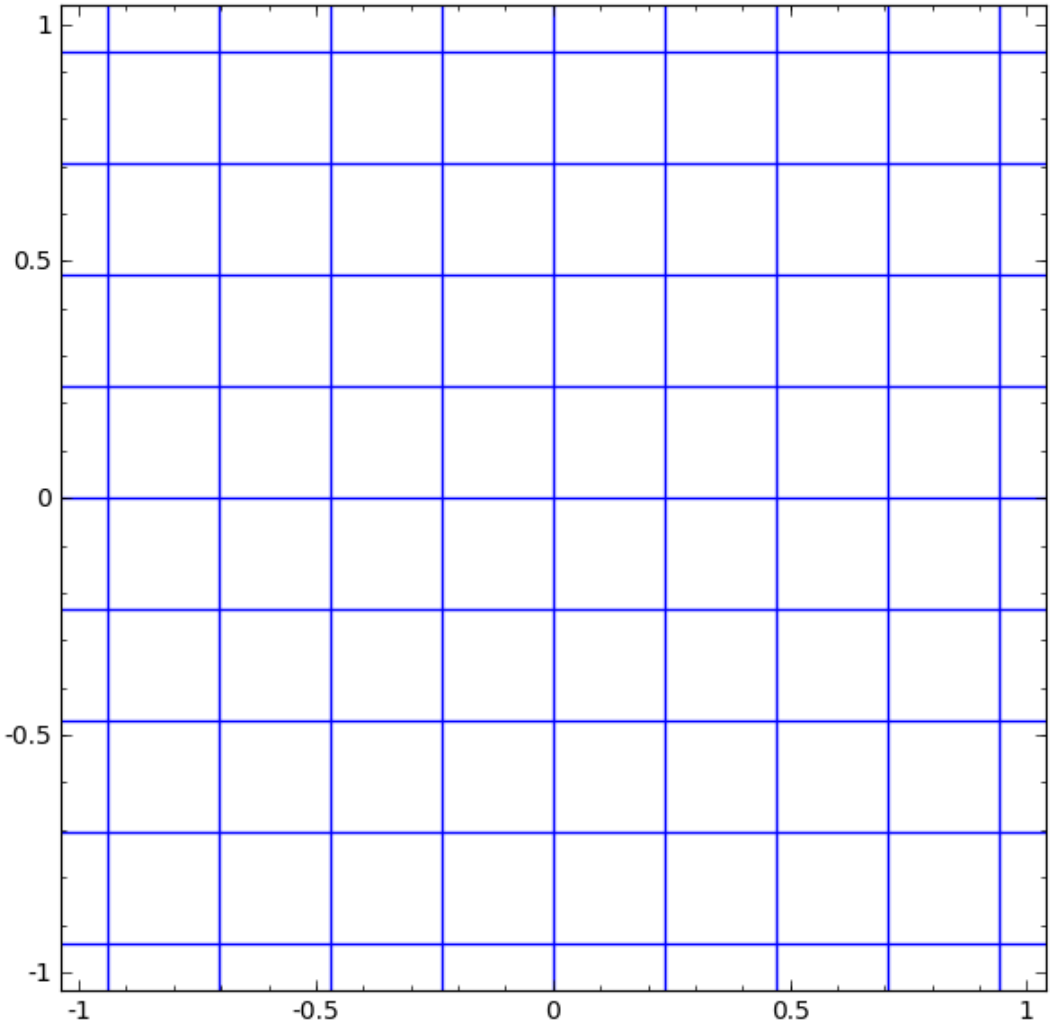
1
0.5
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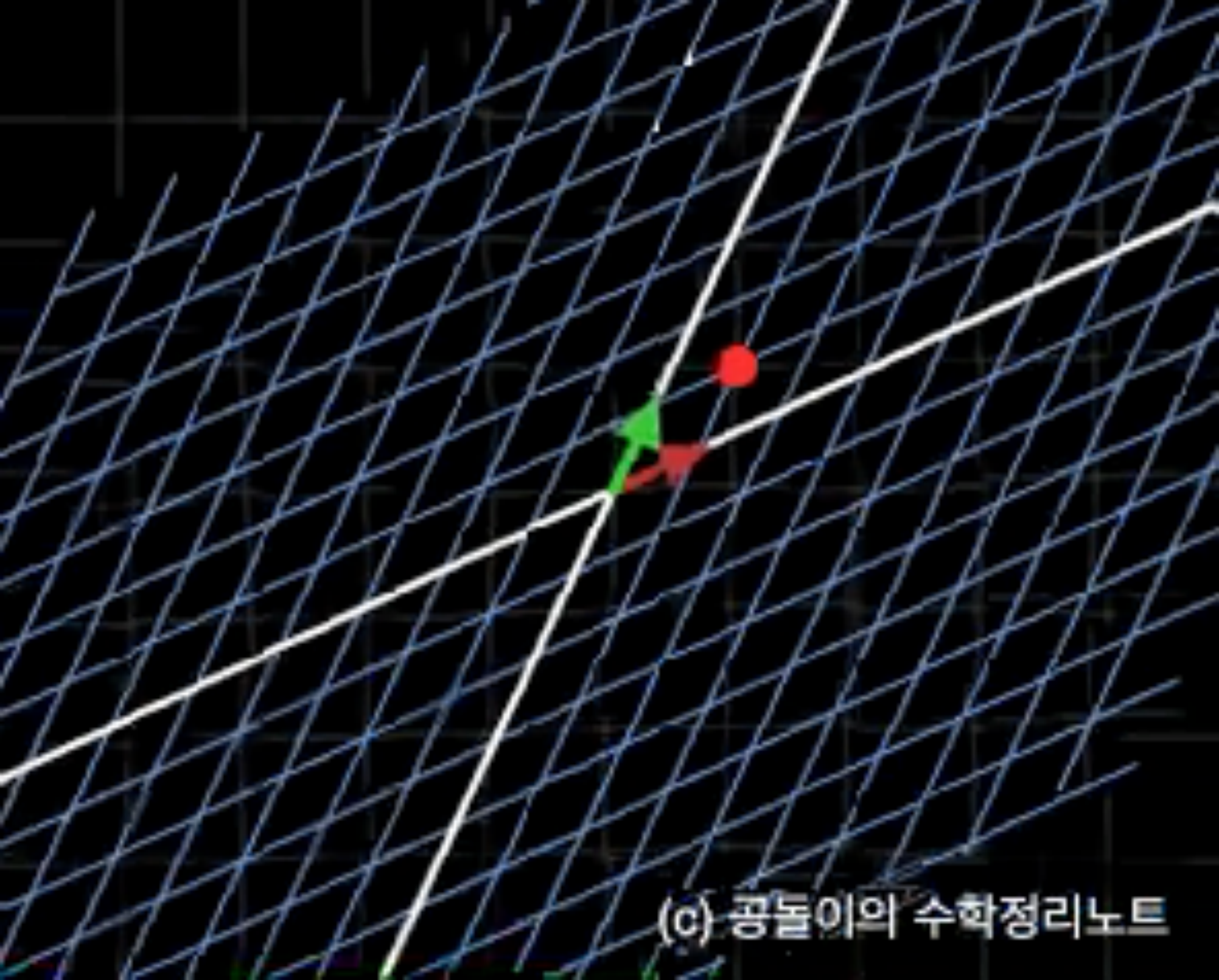
-1
-0.5
0
0.5
1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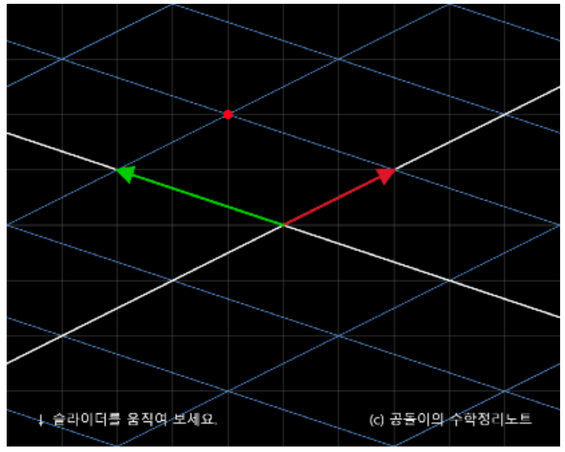
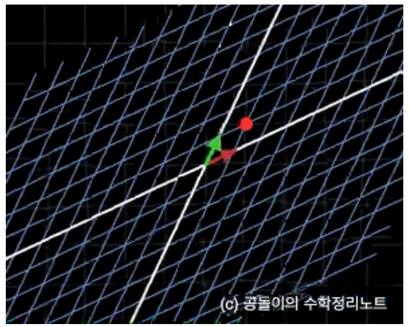
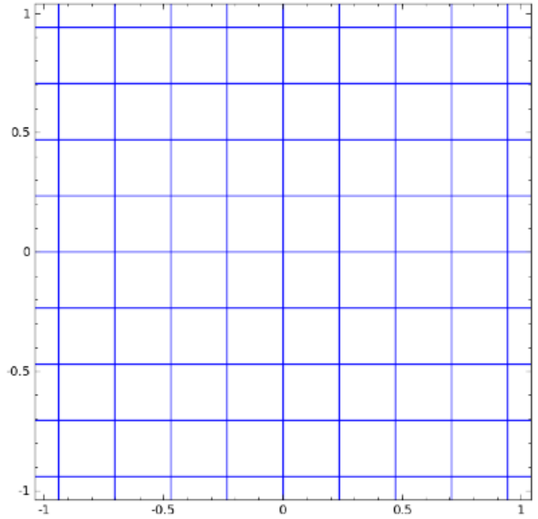


* **shearing**
* **rotation**
* **permutation**
* **projection on ~**



$$A\vec{x} + b$$

(since it has offset, it is non-linear transformation)



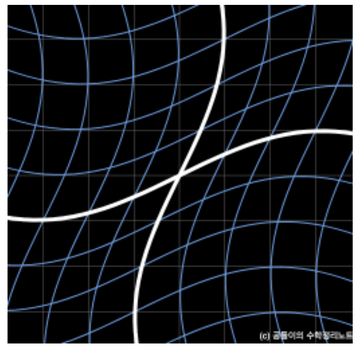
Jacobian Matrix

- Linearlization of non-linear transformation
- definition

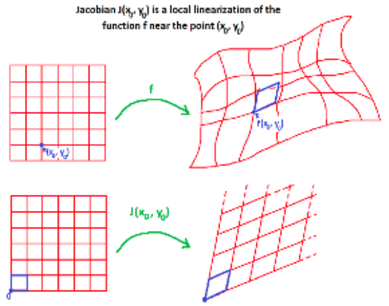
$$J = \begin{bmatrix} \frac{\partial f_1}{\partial x_1} & \cdots & \frac{\partial f_1}{\partial x_n} \\ \vdots & \ddots & \vdots \\ \frac{\partial f_m}{\partial x_1} & \cdots & \frac{\partial f_m}{\partial x_n} \end{bmatrix}$$

- example of non-linear transformation

$$f(x, y) = \begin{bmatrix} x + \sin(\frac{y}{2}) \\ y + \sin(\frac{x}{2}) \end{bmatrix}$$



- *임의의 점(내가 원하는 점)의 기울기만 취한다. = linearlization



- 하려는 것

$$\begin{bmatrix} dx \\ dy \end{bmatrix} = J \begin{bmatrix} du \\ dv \end{bmatrix} = \begin{bmatrix} a & b \\ c & d \end{bmatrix} \begin{bmatrix} du \\ dv \end{bmatrix}$$

- 세부 계산

$$dx = a \times du + b \times dv$$
$$dy = c \times du + d \times dv$$

- 따라서 J 행렬은

$$J = \begin{bmatrix} \frac{\partial x}{\partial u} & \frac{\partial x}{\partial v} \\ \frac{\partial y}{\partial u} & \frac{\partial y}{\partial v} \end{bmatrix}$$