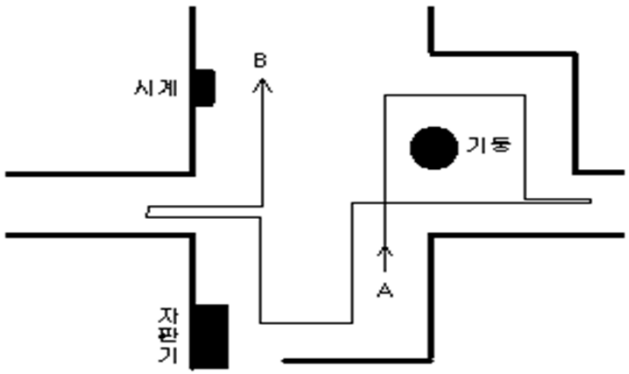
My old memory - SLAM



July 2023

Sangwon Lee

CONTENTS

- ❑ Who I Am
- ❑ LIDAR Data Format and Coordinate Transformation
- ❑ Coordination Transformation
- ❑ Virtual Boundary, Robot View, and PC View (Global Mapping)
- ❑ Old Paper (Autonomous Mobile Robot, 1999)

Who I Am

- 2022.4 ~ : Broadcom IFPD, Flame and Gas Sensor Consultant
- 2014.1 ~ 2022.3 : Pyreos FAE for Flame and Gas Detector Development
- 2008 ~ 2013 : ELT Sensor Senior Engineer, and CTO
- 2002 ~ 2006 : Vehicle Systems, ESA Satellite Antenna engineer
- 1997 ~ 1999 : Faculty of Engineering, ROK Naval Academy

Basic Math 1

- LIDAR Data Format

$$(r_0 , \theta_0), (r_1 , \theta_1), (r_2 , \theta_2) , ..., (r_n , \theta_n)$$

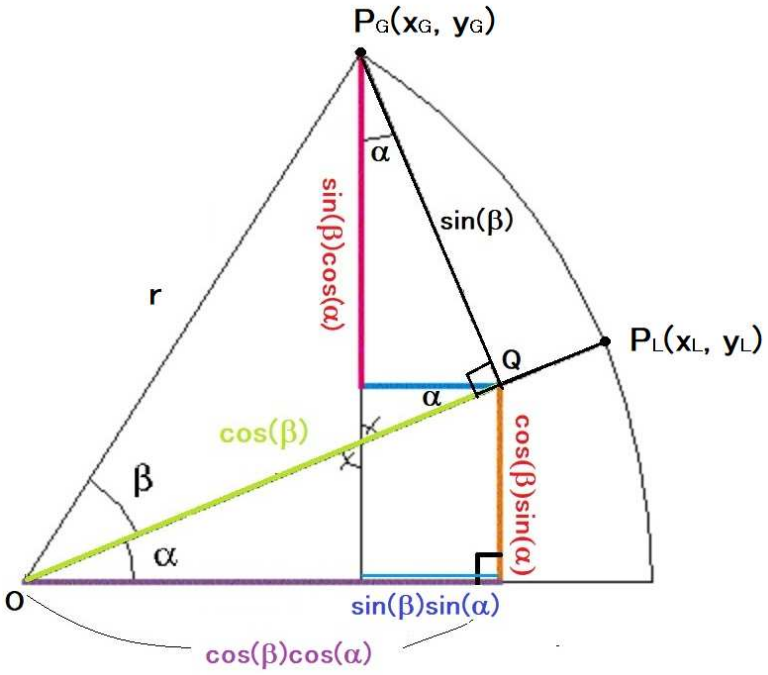
- Coordinate Transformation: $(\theta_n , r_n) \rightarrow (x_n , y_n)$

$$x_n = r_n \cdot \cos(\theta_n), \; y_n = r_n \cdot \sin(\theta_n)$$

$$(x_0 , y_0), (x_1 , y_1), (x_2 , y_2) , ..., (x_n , y_n)$$

Basic Math 2

- Basic Math: $\sin(\alpha+\beta)\,,\cos(\alpha+\beta)$



- $x_L = r \cdot \cos(\alpha),\ y_L = r \cdot \sin(\alpha)$
- $x_G = r \cdot (\cos(\alpha) \cdot \cos(\beta) - \sin(\alpha) \cdot sin(\beta))$
- $y_G = r \cdot (sin(\alpha) \cdot \cos(\beta) + \cos(\alpha) \cdot sin(\beta))$

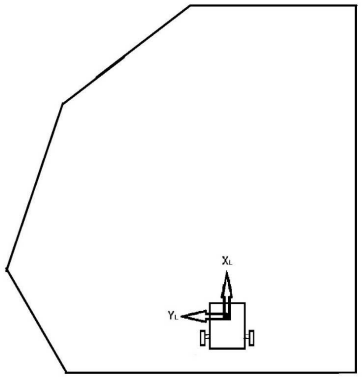
- $x_G = x_L \cdot \cos(\beta) - y_L \cdot sin(\beta)$
- $y_G = y_L \cdot \cos(\beta) + x_L \cdot sin(\beta)$

Basic Math 3

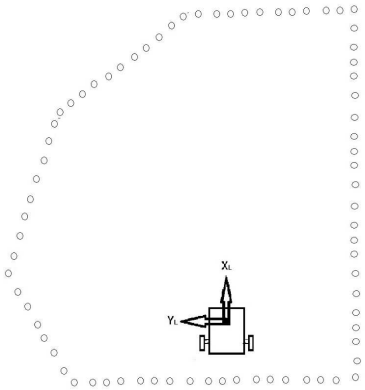
- $x_G = x_L \cdot \cos(\beta) - y_L \cdot sin(\beta)$
- $y_G = x_L \cdot sin(\beta) + y_L \cdot \cos(\beta)$
- $\begin{bmatrix} x_G \\ y_G \end{bmatrix} = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \begin{bmatrix} x_L \\ y_L \end{bmatrix} + \begin{bmatrix} x_{imu} \\ y_{imu} \end{bmatrix}$
- $\begin{bmatrix} x_G \\ y_G \\ 1 \end{bmatrix} = \begin{bmatrix} \cos(\theta_{imu}) & -\sin(\theta_{imu}) & x_{imu} \\ \sin(\theta_{imu}) & \cos(\theta_{imu}) & y_{imu} \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x_L \\ y_L \\ 1 \end{bmatrix}$

SLAM 1

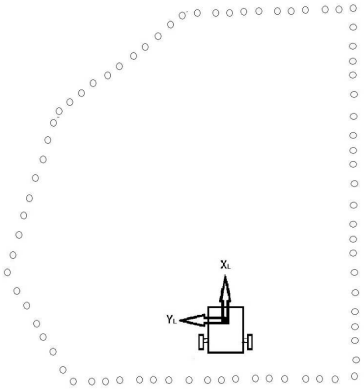
❑ Simultaneous Localization And Mapping – SLAM



Virtual Boundary Environment



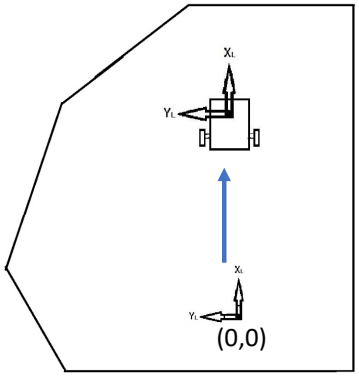
ROBOT VIEW



PC VIEW (Global Mapping)

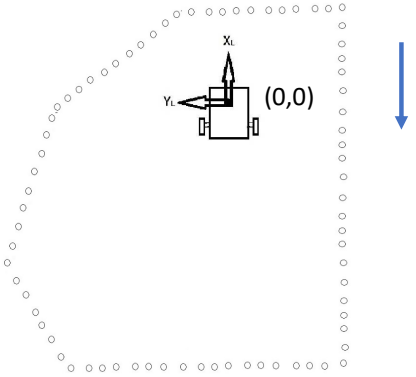
SLAM 2

❑ Move $+x$ direction (LIDAR position + x_{imu})

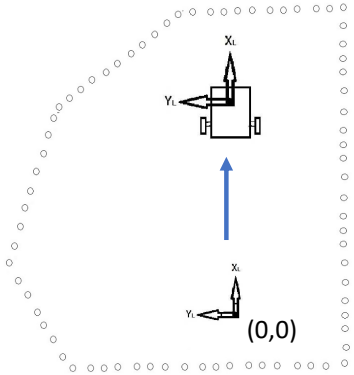


Virtual Boundary Environment

$(x_{imu}, y_{imu}, \theta_{imu})$



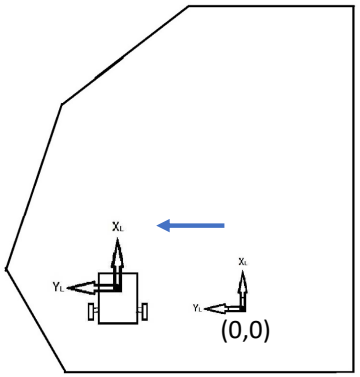
ROBOT VIEW



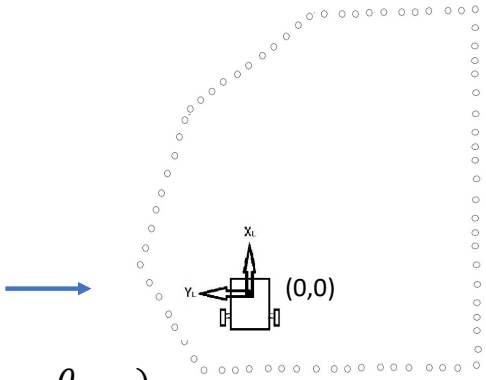
PC VIEW (Global Mapping)

SLAM 3

❑ Move $+y$ direction (LIDAR position + y_{imu})

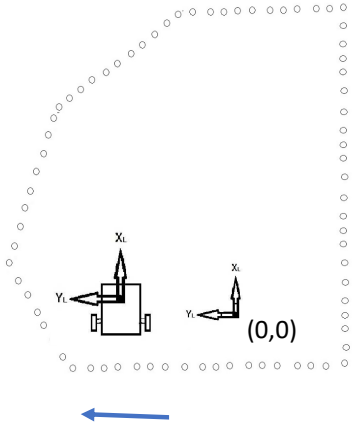


Virtual Boundary Environment



(x_{imu} , y_{imu} , θ_{imu})

ROBOT VIEW

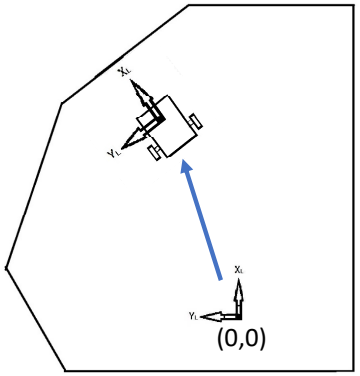


PC VIEW (Global Mapping)

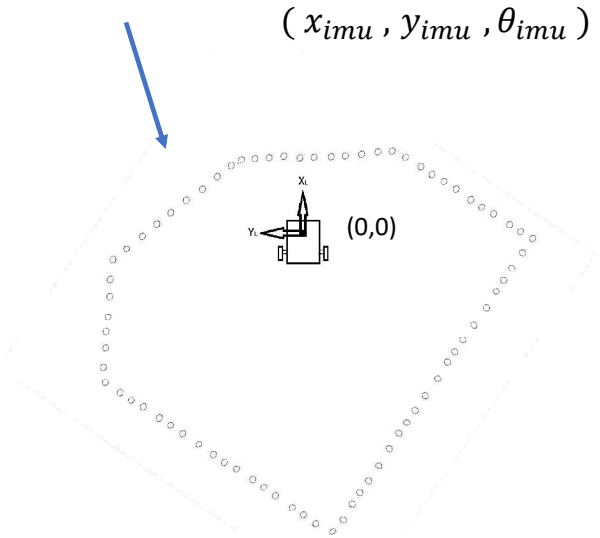
SLAM 4

SLAM – Stimulus Localization And Mapping

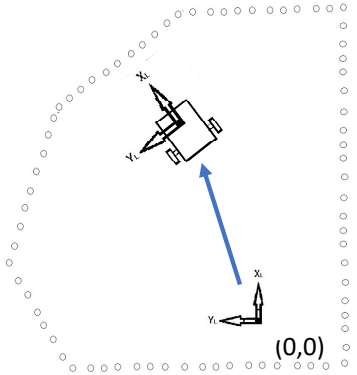
❑ Move $+x, y, \theta$; LIDAR position $+ x_{imu}, y_{imu}, \theta_{imu}$



Virtual Boundary Environment



ROBOT VIEW



PC VIEW (Global Mapping)

Old Paper

- 1999, Research for ------ Remote Controlled Robot