



# Position Sensorless Control for High-Power-Density PMSM based on Pattern Matching Method

## Background

1. Issues with using position sensor for control Interior Permanent Magnet Synchronous Motors(IPMSMs)

- Unit reliability
- High cost
- Larger installation space

**Position sensorless control** is focused

2. Features of IPMSM used in automobile industry(HEV, EV)

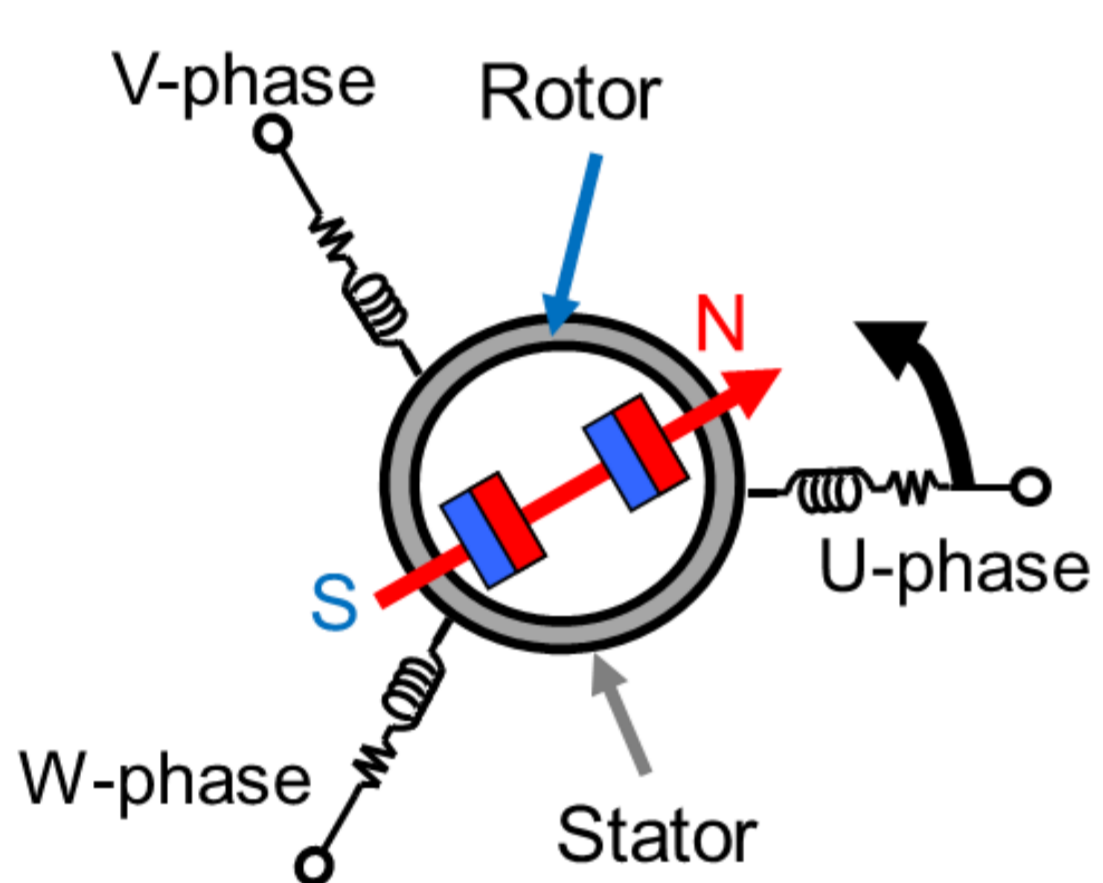
- High power density
- Limitation in installation space

It is easy to be Magnetic saturation state

※ Structure of IPMSM

※ Position sensor

※ Application field of IPMSMs



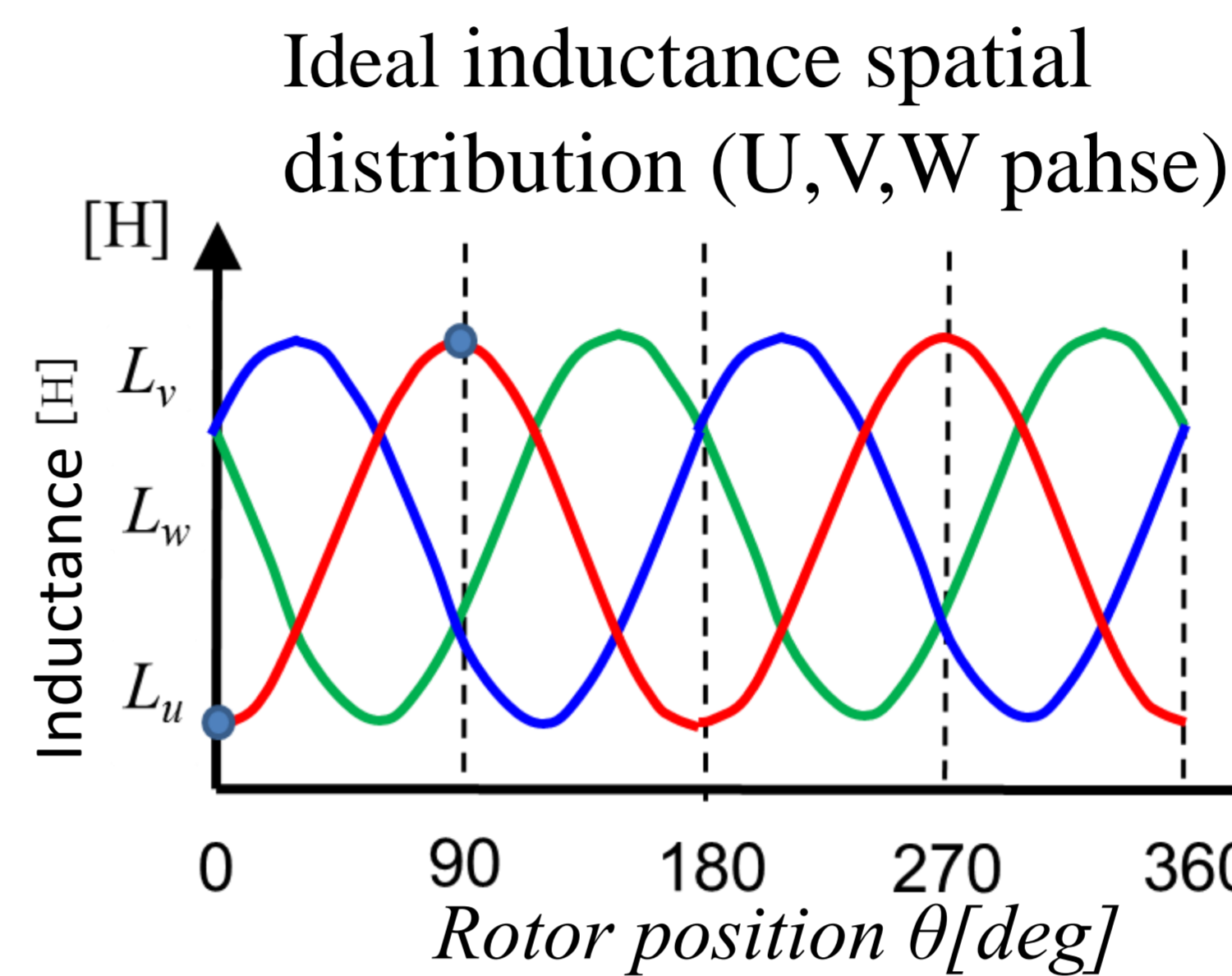
## Conventional method of position sensorless control

(at standstill & low speed region)

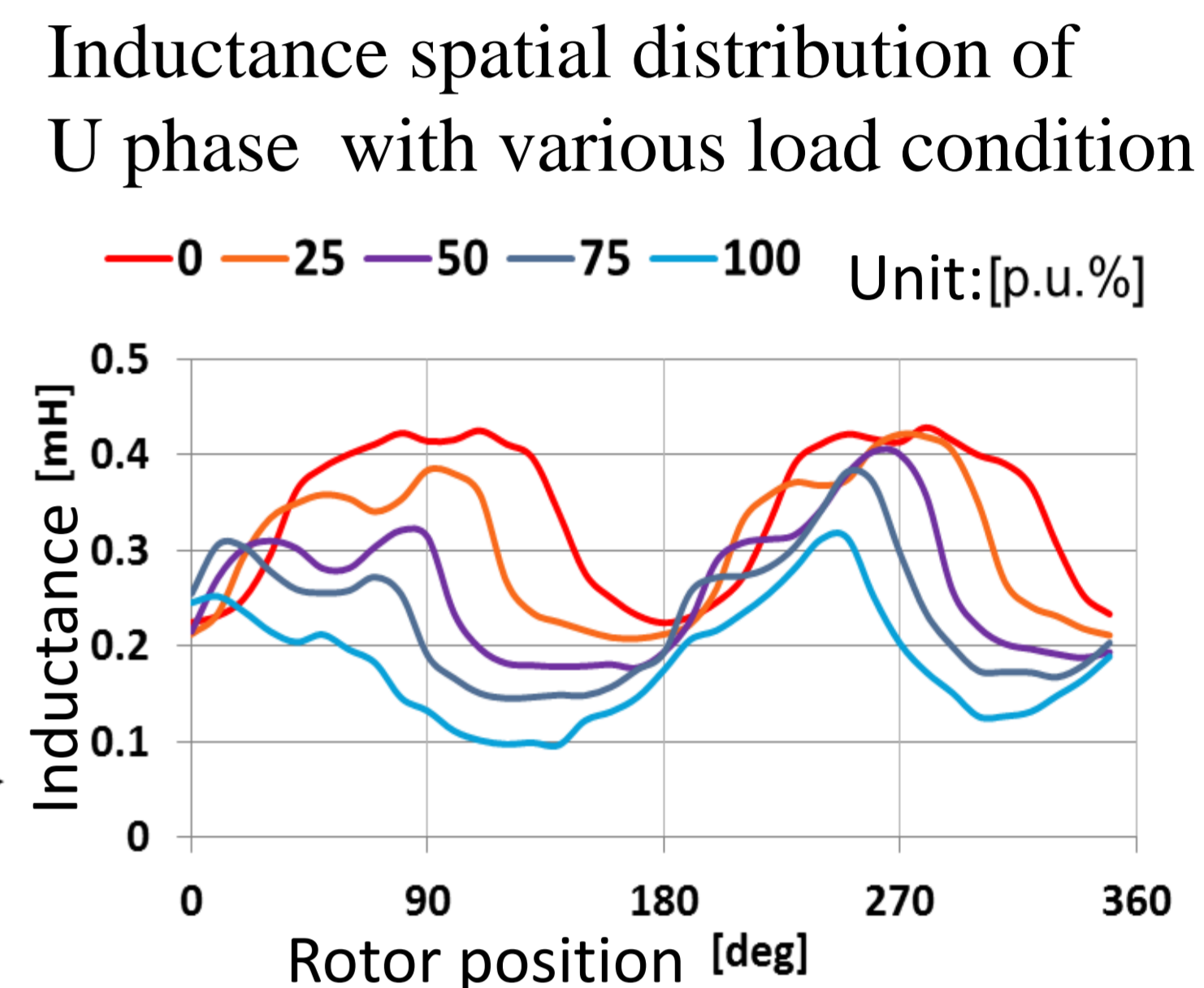
: High-frequency signal injection method estimates the rotor position using the characteristic of sinusoidal inductance spatial distribution generated by saliency of IPMSMs

**It is difficult to apply signal injection method for IPMSMs with magnetic saturation, because the inductance spatial distribution is distorted**

※Magnetic saturation X



※Magnetic saturation



## Aim of Study

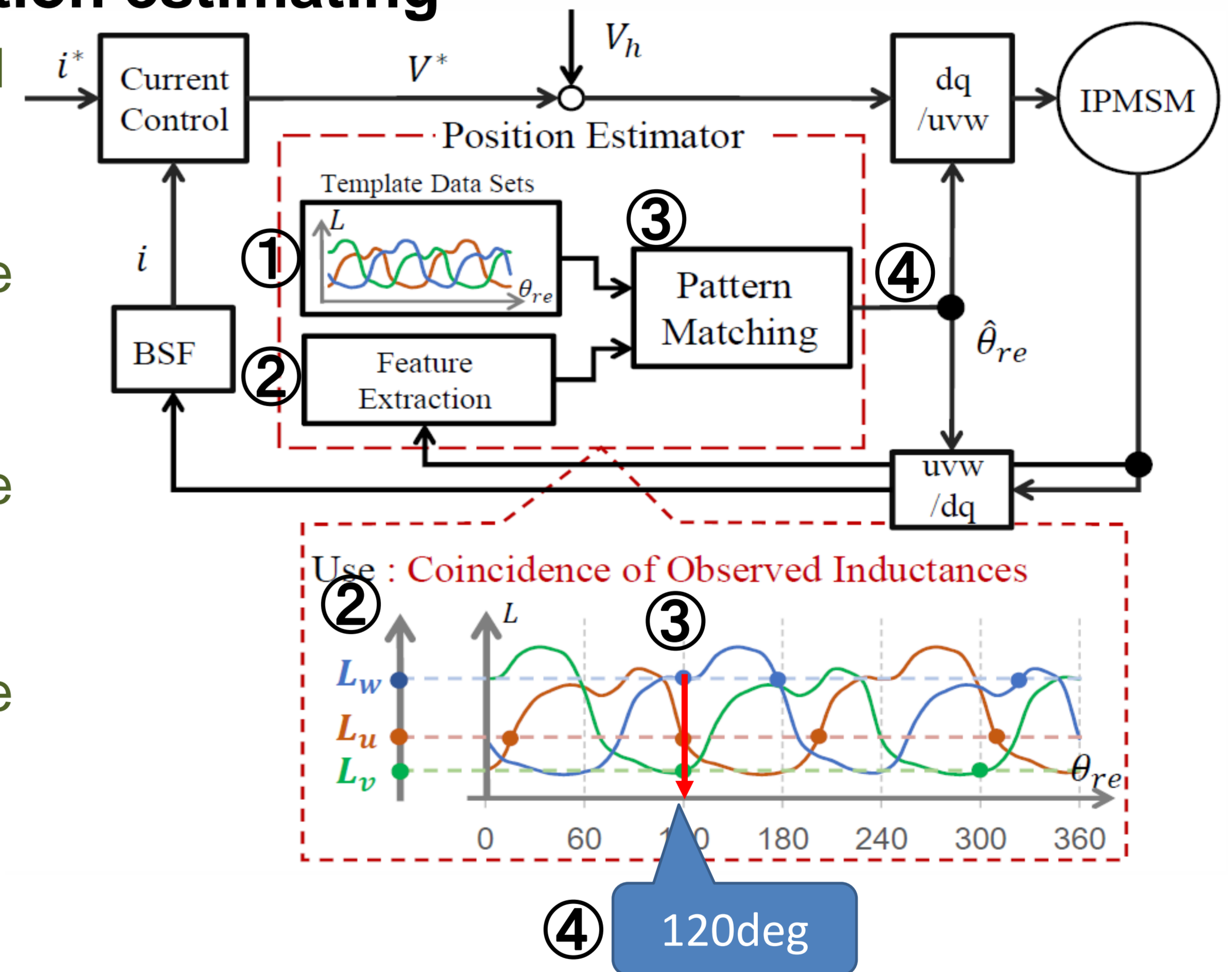
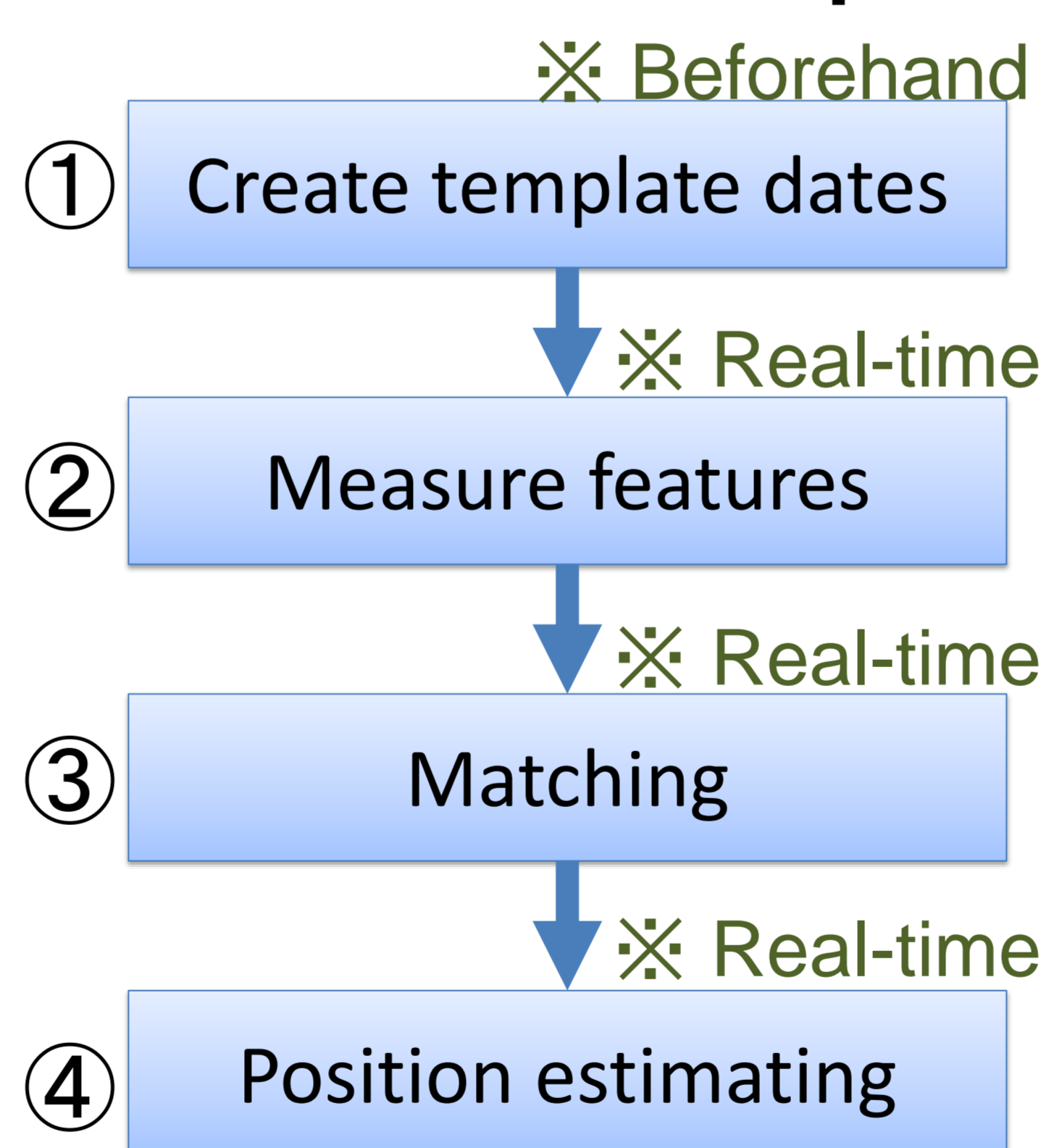
**Position sensorless control for IPMSMs in standstill and very low speed region with non-sinusoidal inductance spatial distribution**

## Position sensorless control based on Pattern Matching method

### Position estimating based on pattern matching method

: It is possible to estimate the rotor position even in the heavy magnetic saturation region by comparing the inductance values measured in a real-time with the values in the template that is prepared beforehand.

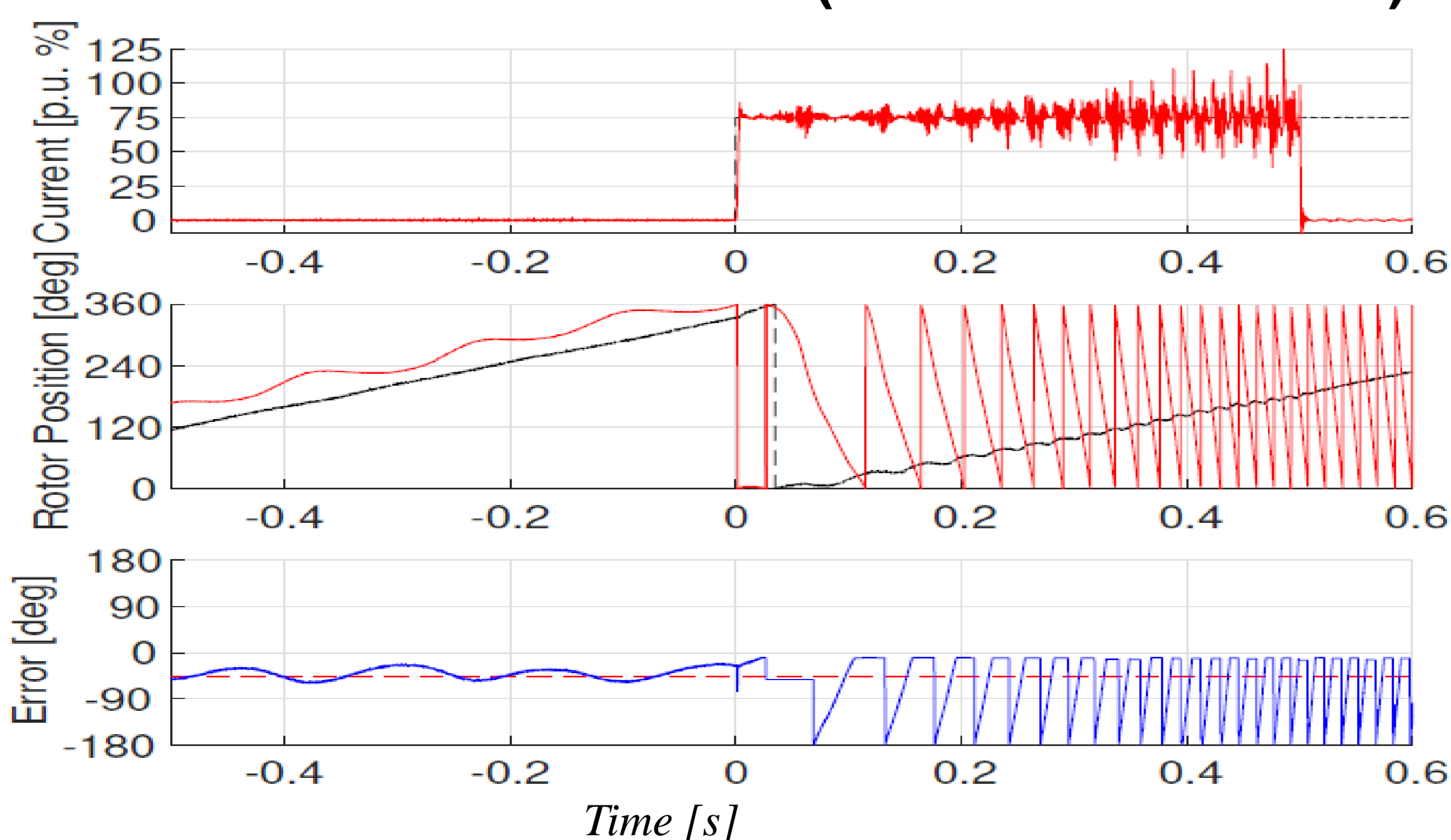
### Procedure of position estimating



### Experimental Results of position sensorless control

※ Experimental Condition : Transient Step form 0% to 75% rated current

Conventional method (mathematical model)



Proposed method (pattern matching method)

