MATLAB EXPO

모델 기반 설계를 이용한 광전 센서 성능 예측 모델

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MathWorks

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About Autonics

Autonics is a globally trusted provider of industrial automation products from South Korea.

Autonics is a leading provider of automation solutions in South Korea. We develop and manufacture a wide range of automation-related products which are marketed worldwide. Our core products include various sensors, control devices, motion devices, process automation instruments, control switches, and peripheral connection equipment.

Our products are trusted and adopted by engineers in various industrial applications including food manufacturing & packaging, plastic & rubber processing, semiconductor equipment, and metalworking machinery.

Our technology is also widely applied in day-to-day automation devices including elevators, screen doors, ATM machines, CCTVs, and electronic office equipment.

Overview

Make Life Easy : Autonics

Headquartered in
South Korea

Korea's Top
Automation Company

Specializes in
Industrial Automation

Provides
Total Solutions

Manufacturer of
Sensors
Controllers
Motion Devices
& More

Global Network

Autonics global network consists of 12 international offices and 150 distributors spanning over 100 countries. With a vast sales and technical support network, Autonics is able to provide comprehensive automation solutions for our customers across the globe.

Our experts around the world are working day and night to constantly deliver new and improved values, so that we can contribute to improving the quality of life and creating
a more convenient world.

12 International Offices

150 Distributors

100 Countries

Research & Development

Autonics R&D Center
(Seoul, S. Korea)

Autonics R&D Center is the hub of research and development aiming to advance current technology and securing new source technology. The R&D center also promises to strengthen research capabilities for diverse automation solutions across all industries.

Quality & Production Technology & Production Department

Reliability Control Center

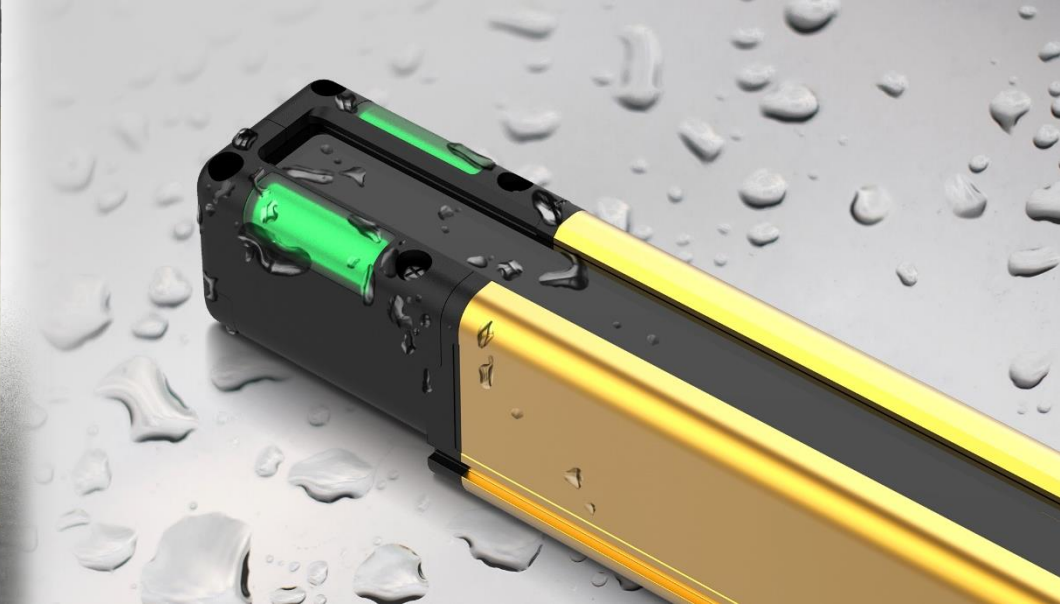
(Busan, S. Korea)

The Autonics product reliability center features state of the art equipment capable of EMC tests, to expand the certification and reliability of our products.

Products

- Sensor
- Controllers
- Motion Devices
- Connectivity
- Control Switches
- Software
- Field Instruments

Safety System



Safety products are installed in potentially dangerous or hazardous areas to safeguard personnel from injury and protect equipment from damage.

Safety Light Curtains

- Safety Light Curtain

Safety Switches

- Door Switches
- Door Lock Switches
- Safety Non-Contact Door Switch
- E-Stop Push Button Switches

Safety Controllers

- Controllers
- Relay Units

Sensors

Sensors are the most essential and commonly used components in automation systems. Autonics provides a wide variety of industrial and commercial sensors, ensuring that the most fundamental parts of automation systems are built with quality and performance.

Displacement Sensor

Vision Sensor

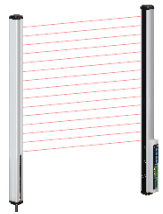
LiDAR

Proximity Sensors

Photoelectric Sensors

Fiber Optic Sensors

Area Sensors



Controllers

Controllers are widely used in various industrial settings to adjust or maintain desired outputs of specific processes within a desired range. Autonics provides a diverse range of highly accurate and reliable controllers for stable and ideal system control.

Temperature Controllers

Solid State Relays

Power Controllers

SMPS

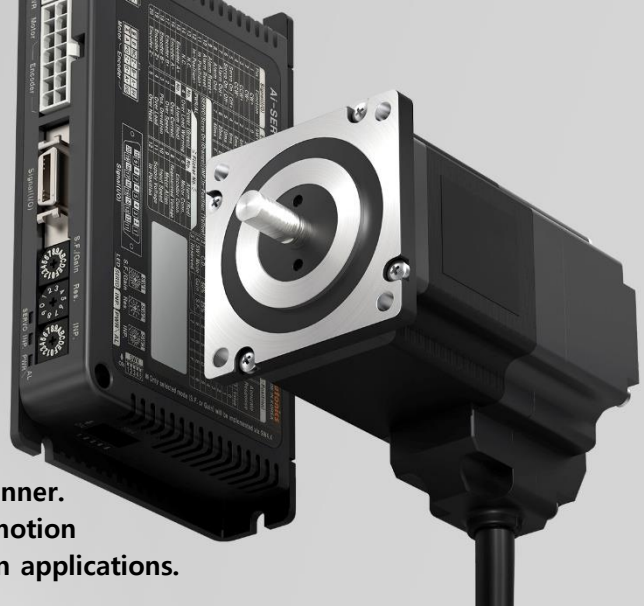
Counter

Timer

Industrial PC

HMIs

Motion Devices



Motion control involves automation of moving parts of machines in a controlled manner. Autonics motion devices, consisting of stepper motors, stepper motor drivers, and motion controllers, provide comprehensive solutions well-suited for a wide variety of motion applications.

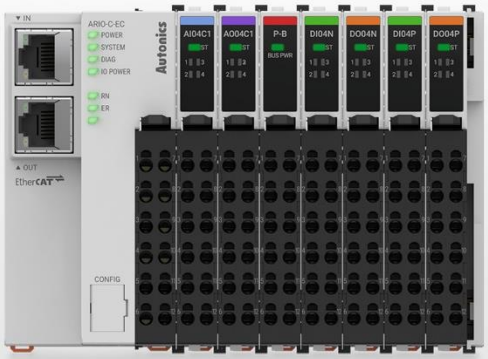
Closed Loop Stepper Motor & Drivers

Motion Controllers

5-Phase Stepper Motor & Drivers

2-Phase Stepper Motor Drivers

Connectivity



Connectivity devices are communication devices used to send and receive signals or data between the environment and information processing systems.

Field Network Devices

Distribution Boxes

Valve Plugs

I/O Terminal Blocks

Connectors

Socket

Software

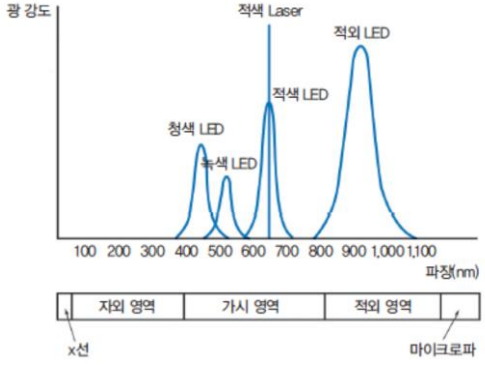
Autonics software offers intuitive GUI interface and simple settings, allowing users to easily configure parameters, monitor and save important data, and create various programs for diverse Autonics products.

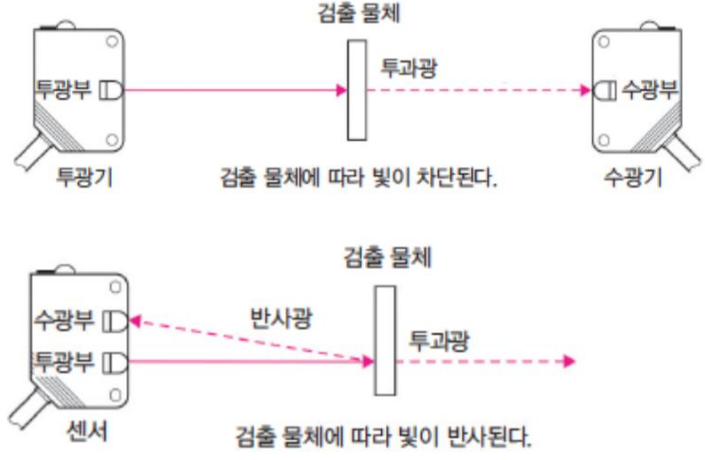
Software

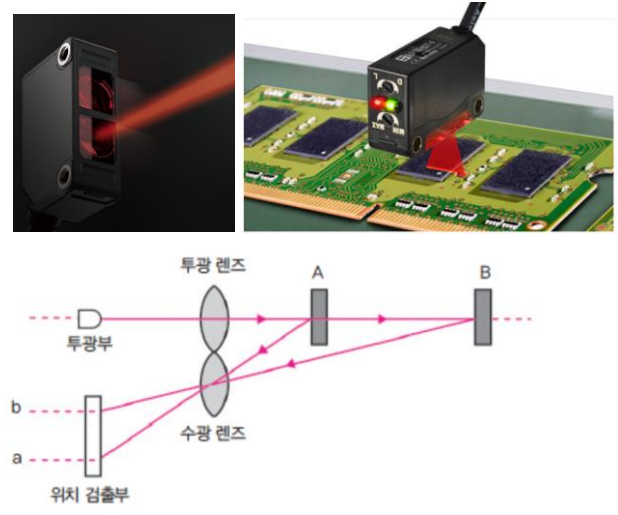
- Device management software (DAQMaster)
- Vision system management software (Vision Master)
- Laser scanner management software (atLidar)
- Motion device management software (atMotion)
- Logic programming software (atLogic)
- GP/LP screen editor (atDesigner, GP Editor)
- DS/DA time sync software (World Clock)

Optical Sensors

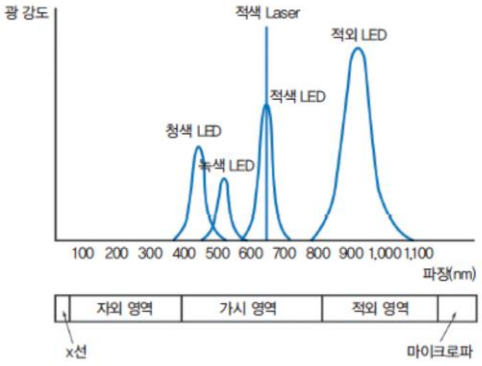
- A sensor that identifies the position(X, Y, Z) / Color / Size of an object of interest using light (visible & infrared light)

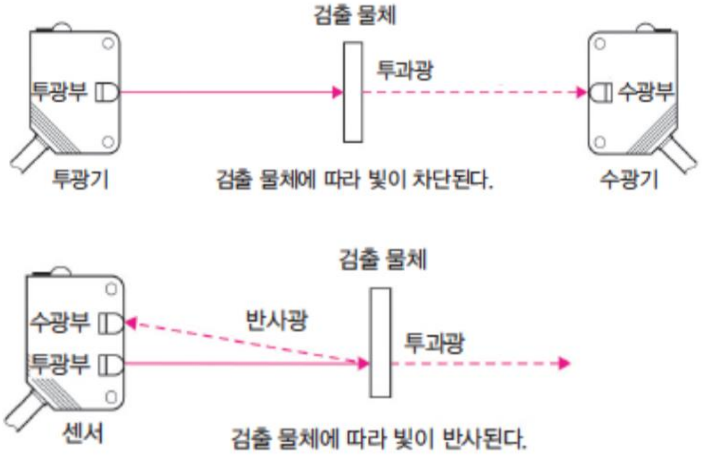


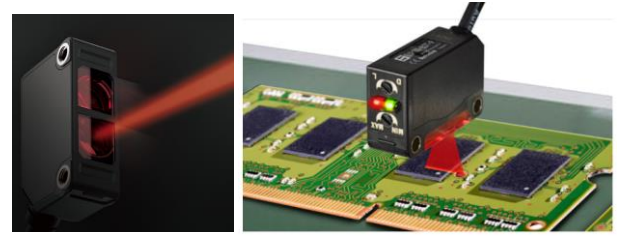


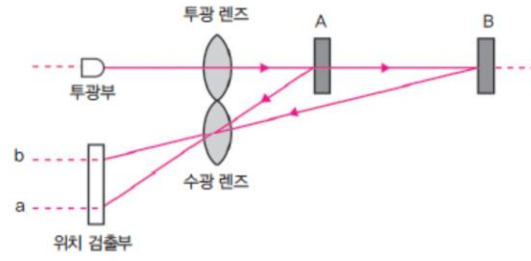


Optical Sensors









Classification of Optical Sensors

Single Beam Sensor

Displacement

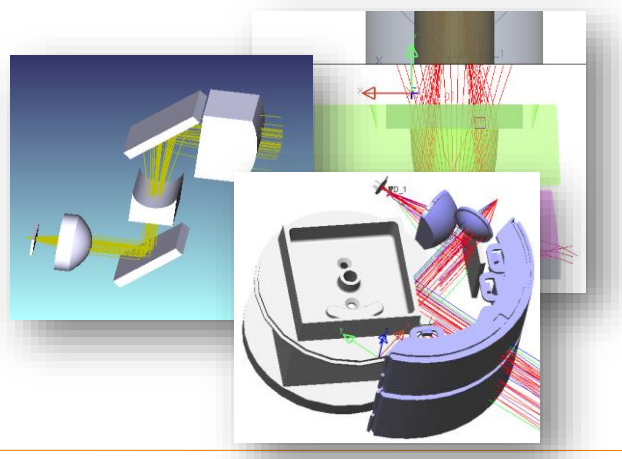
Mapping Sensor

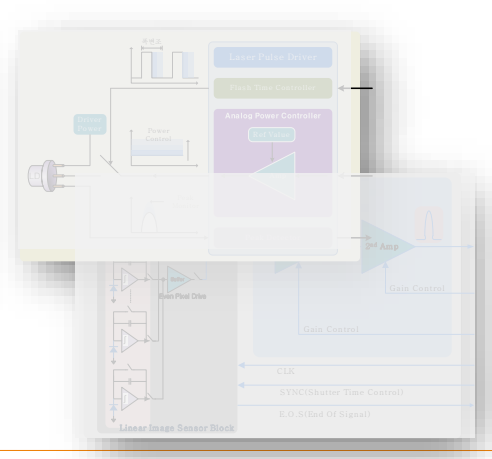
Safety Light Curtain

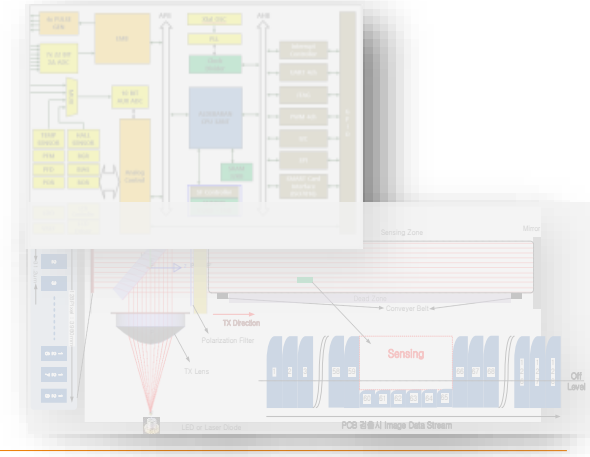
Color Mark Sensor

Optical Sensor Element Technology

- **Optical Design**
  - Optical elements, lenses, and optical systems to emit and receive light
  - Mechanical optical axis alignments of optical elements and optical systems.

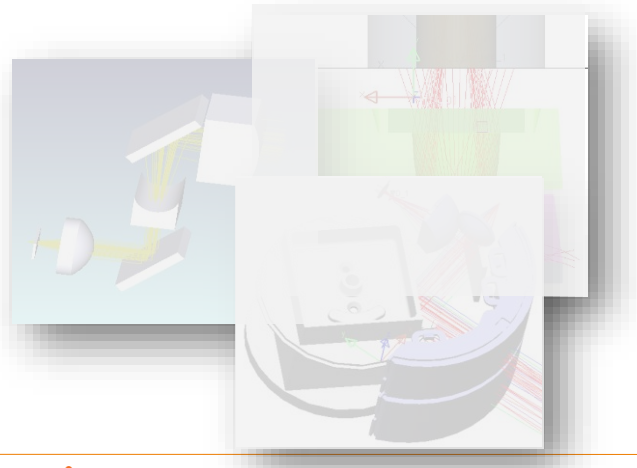


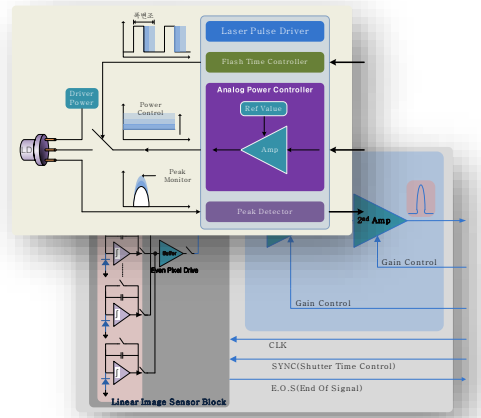


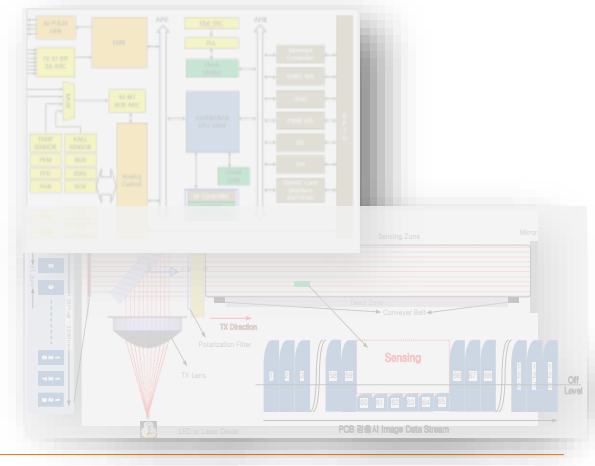


Optical Sensor Element Technology

- **Hardware Design**
  - To handle the emitted light
    ※ Precision/high speed control processing
  - To process receiving light signals
    ※ Light-receiving circuit design for high-speed response
    ※ Noise removal processing for small signal

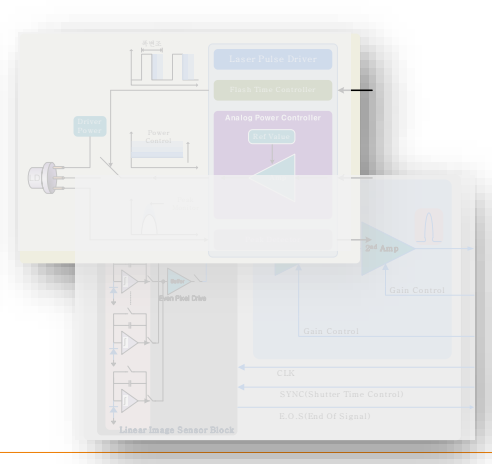


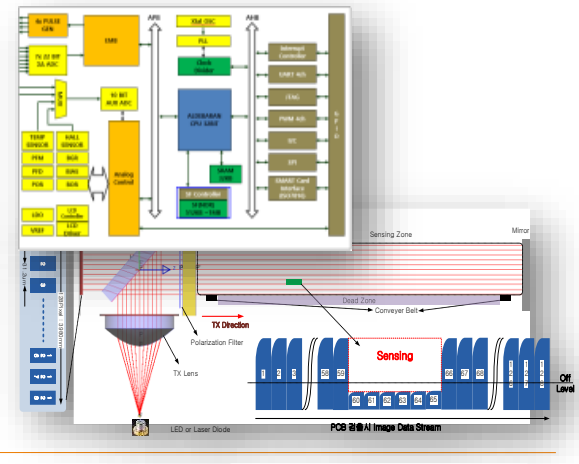




Optical Sensor Element Technology

- **Software Design**
  - Optical systems and H/W In/Out control
  - Disturbance noise avoidance algorithm
  - Algorithm for clear identification of various targets against surroundings.





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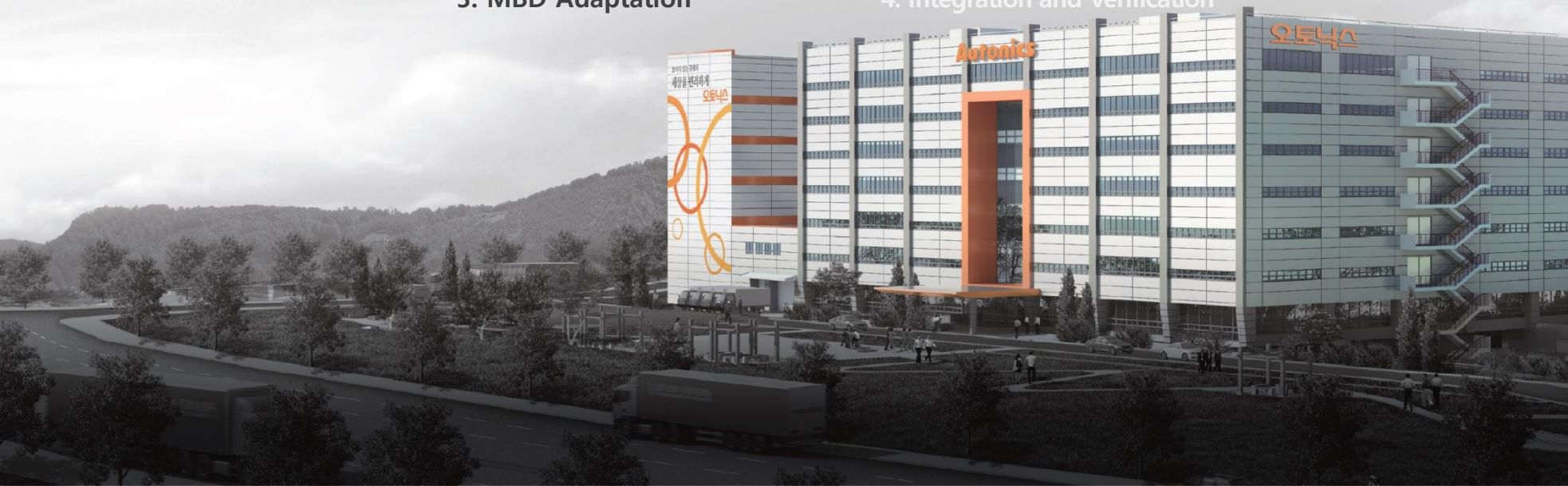
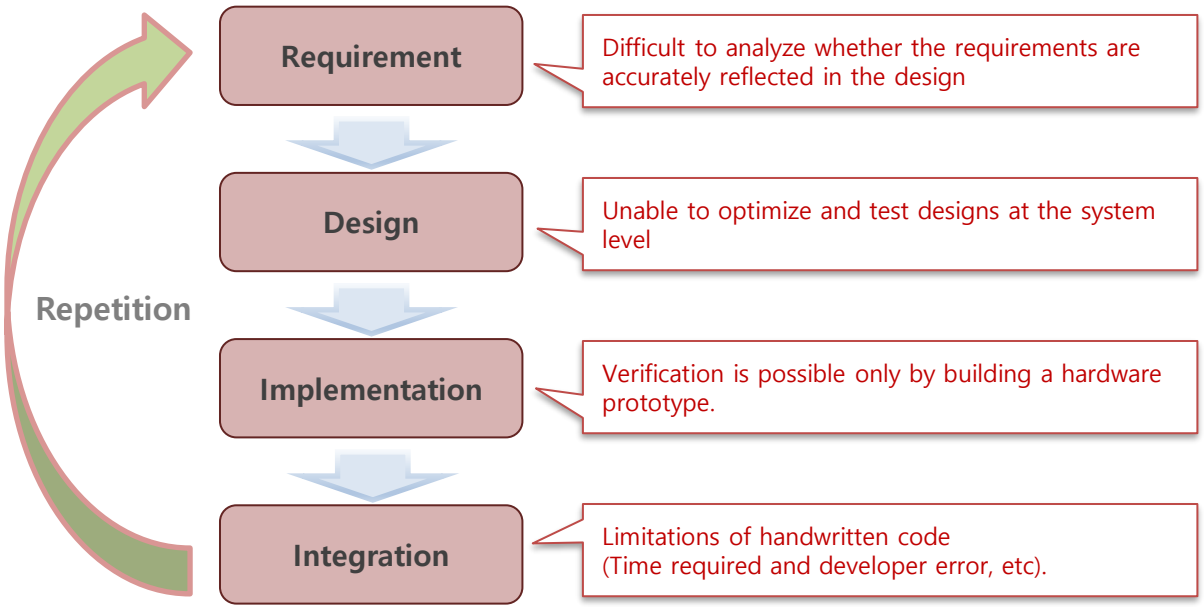


Conventional Development

- Inconsistency between Requirement, Design and Implementation
- Cost and Time consuming to debug after Implementation
- Too much Legacy Code

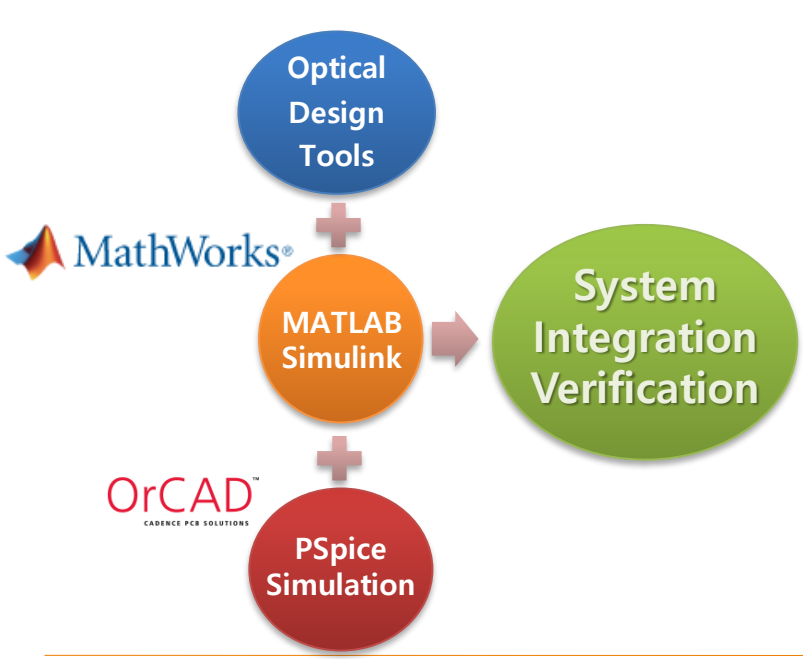


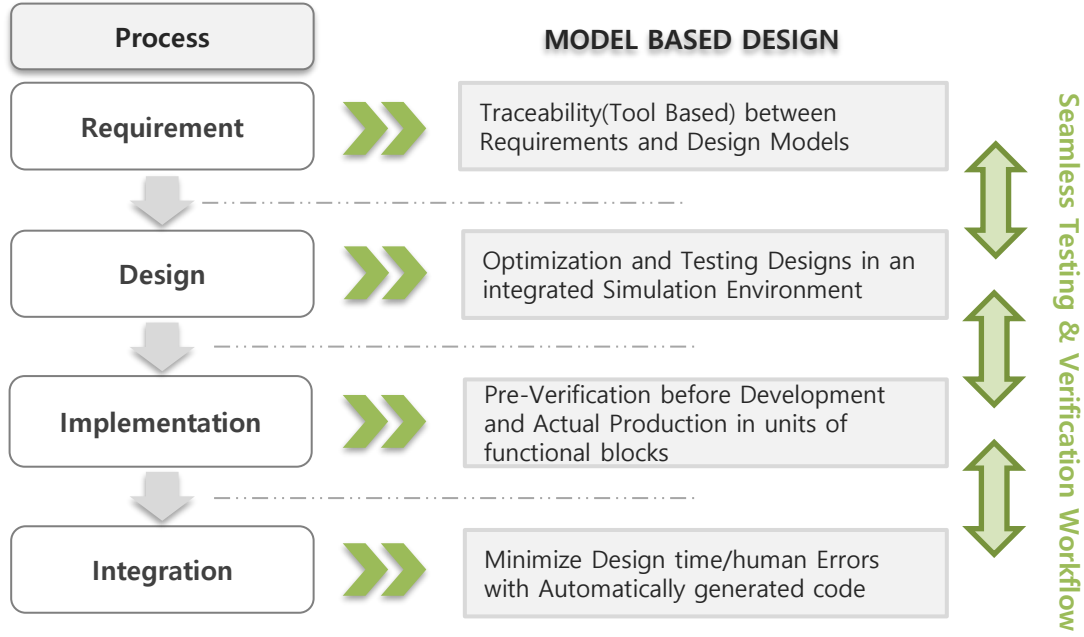
Purpose

- Analysis workflow based on Simulation
- Prevention of Human Errors
  - mismatching requirements at the design

MBD Adaptation

- Performance Prediction Analysis in Model-Based Design
  - By Integrating the Electronic circuit(PSpice) and Optical Analysis results in the Simulink Environment





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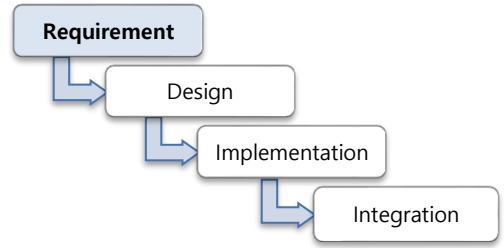
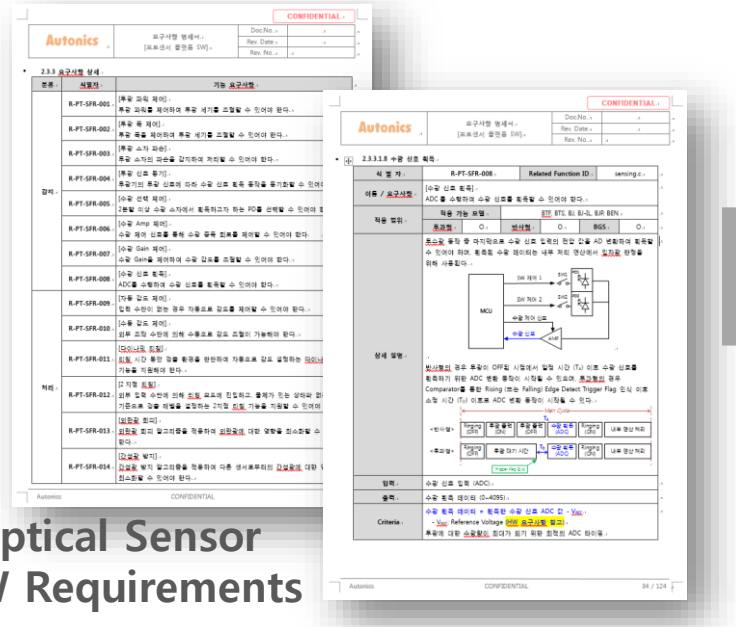
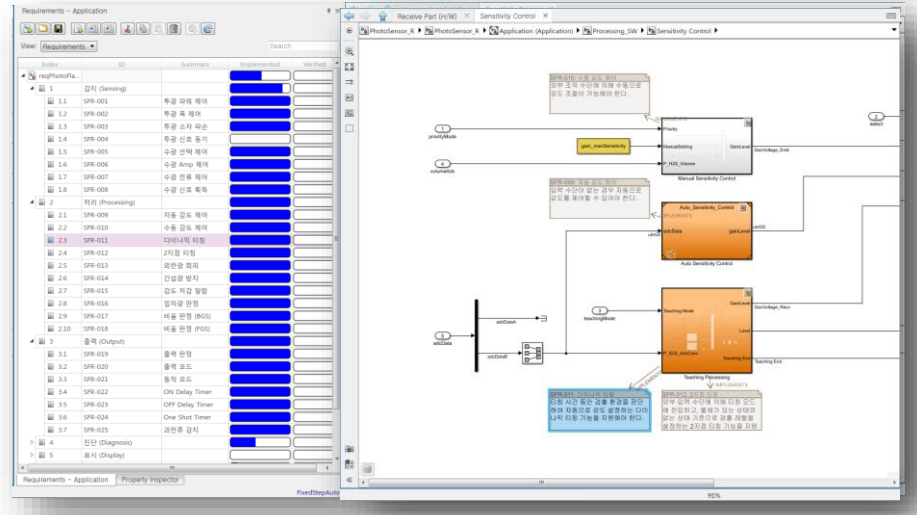
Requirements Management



- Clear Traceability between Requirements and Design
  - Requirement Allocation and System Architecture
  - Requirement-based Design & Traceability Building-up in Simulink



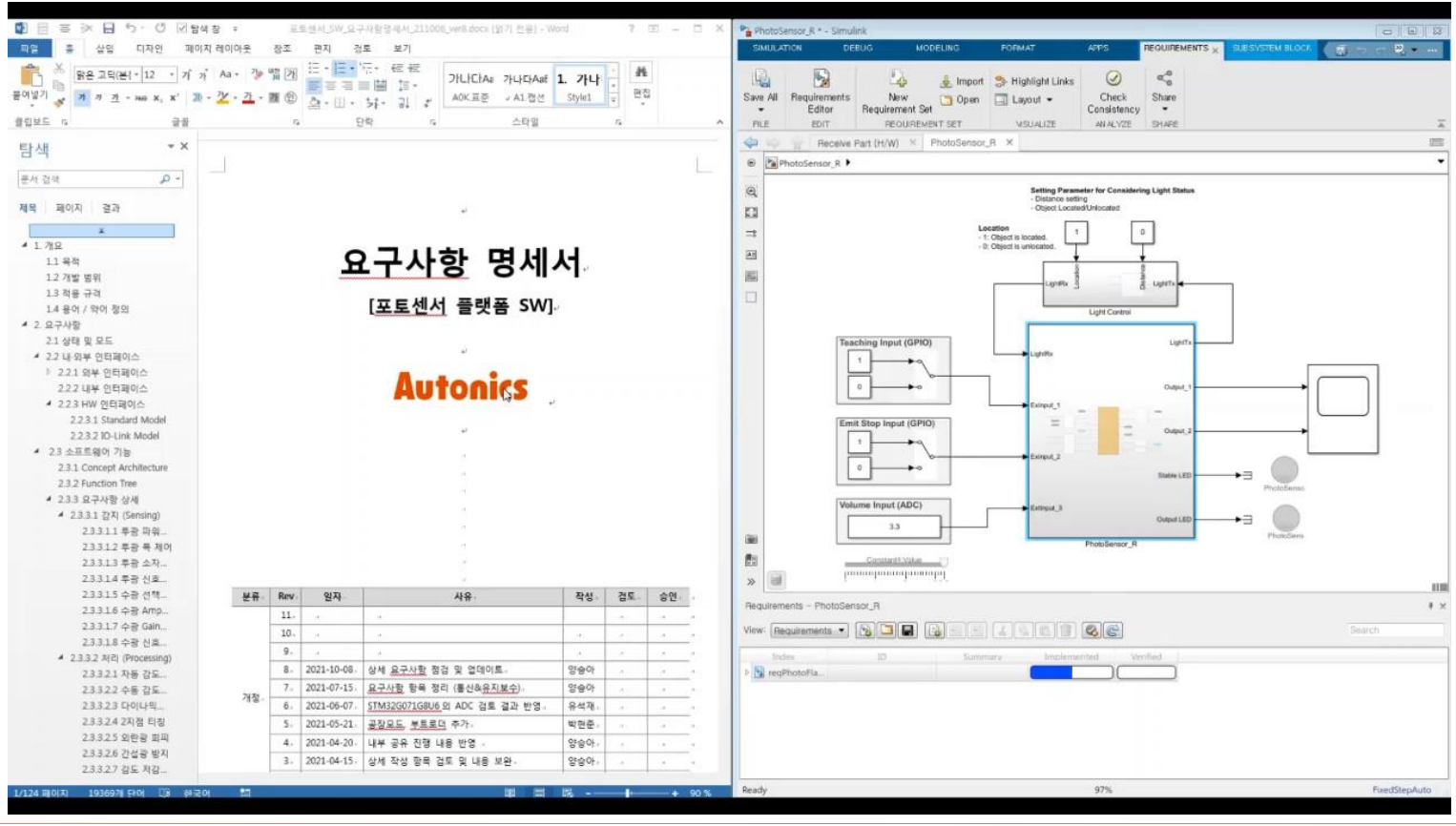
Optical Sensor
S/W Requirements



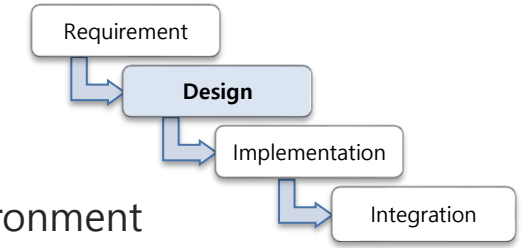
Connect to Simulink Requirement

[Appendix] Action Example 1

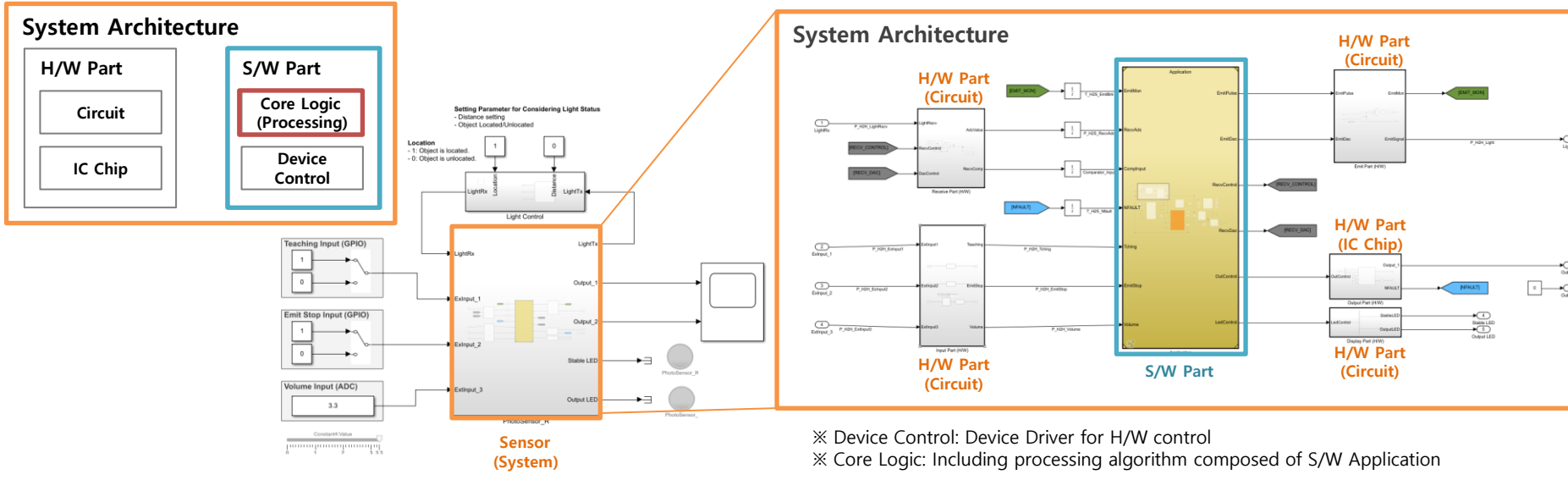
◆ **Simulink - Requirement**



Detailed Design

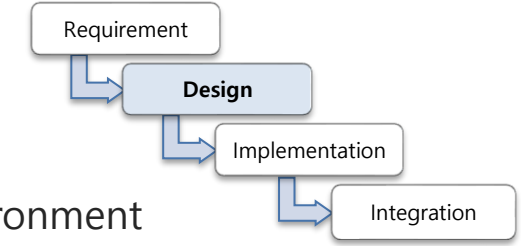


- Design Optimization and Estimation in an Integrated Simulation Environment
  - Configure the Integrated Test Environment based on System Architecture
  - System Configuration ➔ Unit/Integration Test ➔ Code generation



※ Device Control: Device Driver for H/W control
※ Core Logic: Including processing algorithm composed of S/W Application

Detailed Design



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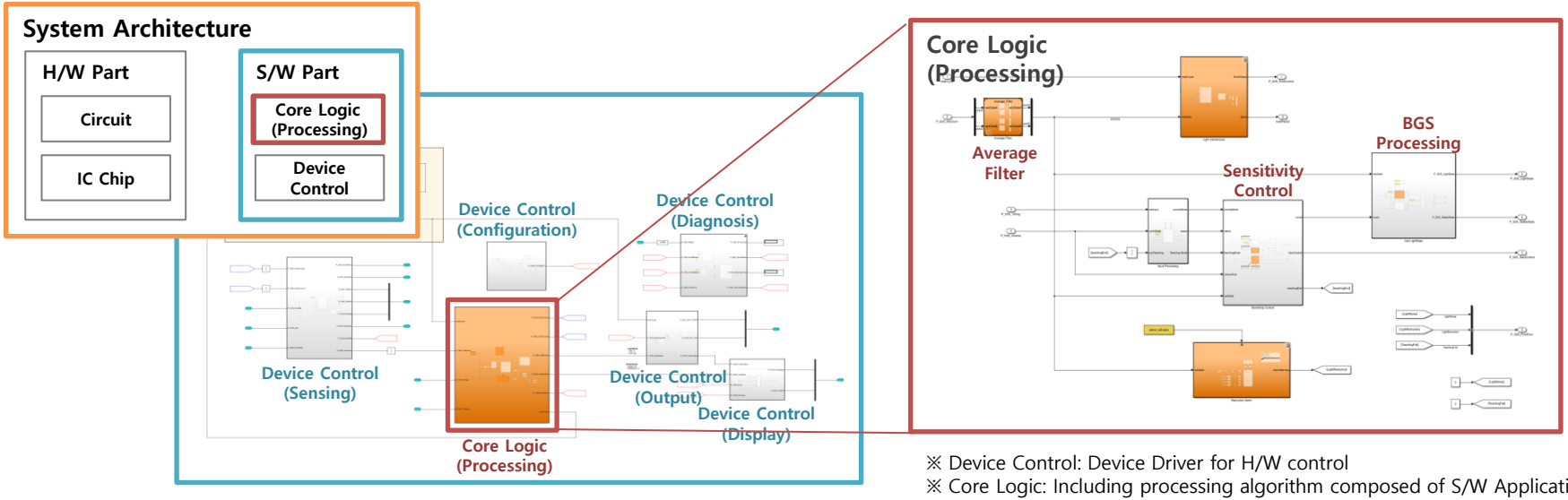


※ Device Control: Device Driver for H/W control
※ Core Logic: Including processing algorithm composed of S/W Application

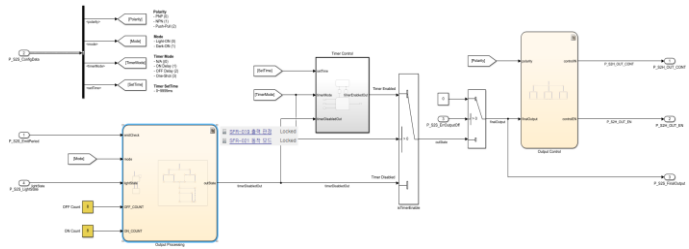
※ BGS : BackGround Suppress

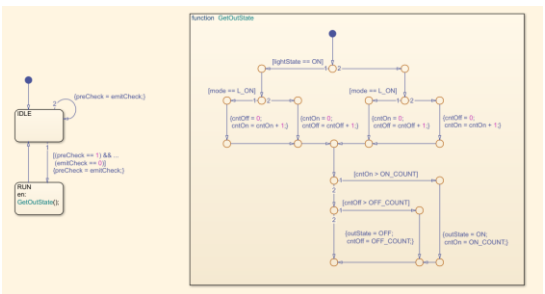
[Appendix] Simulink Module Test

◆ Optical sensor S/W module test

- Configure test harnesses by functional block and identify test cases based on requirement
- Check the simulation result by changing the input conditions according to the test procedure

→ Perform functional unit verification for the designed module

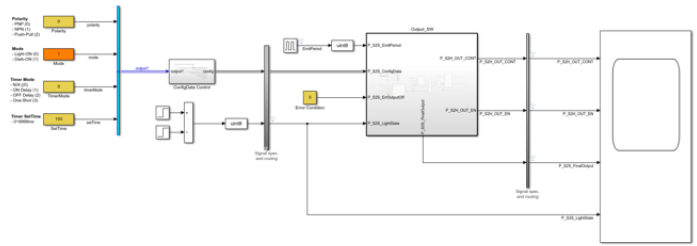




< Modeling block Design >

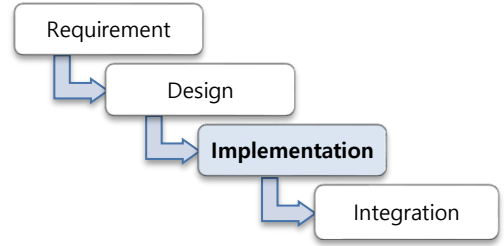
< Test case & Report >

Testing Method	테스트 절차/시나리오	Input Condition	Output Condition	Related Module
Simulink	1. Simulink Output Block 대체 Test Harness를 구성한다. 2. 투수광 Cycle과 동기를 위한 EmitPeriod에 일정 주기의 Pulse 파형을 인가한다. 3. 최종 출력 판정의 값이 변화하도록 수광 판정 입력 조건을 설정한다. 4. 설정 파라미터의 동작 모드를 변경하며 출력 제어 신호의 변화를 확인한다.	동작 모드 (설정 파라미터) 수광 판정 결과 (입/차광 상태)	출력 판정 결과 (점등 결과)	TestHarness_Output_1 Output_SW



No	테스트 조건	입력	출력	테스트 결과	Pass/Fail
1	EmitPeriod : 투수광 동작 사이클에 해당하는 Pulse 신호 인가 (50us) 수광 판정 결과 (LightState) *임의의 입차광 조건 인가 (0.3~0.5s간 입광을 유지)	설정 파라미터: - 동작 모드(Mode) = Light-ON(0) *ON/OFF 카운트는 기본값 적용 (8회)	Light-ON 설정 출력 신호: 수광 판정 결과가 차광일 때, - FinalOutput = 0(OFF) 수광 판정 결과가 입광일 때, - FinalOutput = 1(ON)		Pass
2	EmitPeriod : 투수광 동작 사이클에 해당하는 Pulse 신호 인가 (50us) 수광 판정 결과 (LightState) *임의의 입차광 조건 인가 (0.3~0.5s간 입광을 유지)	설정 파라미터: - 동작 모드(Mode) = Dark-ON(1) *ON/OFF 카운트는 기본값 적용 (8회)	Dark-ON 설정 출력 신호: 수광 판정 결과가 차광일 때, - FinalOutput = 1(ON) 수광 판정 결과가 입광일 때, - FinalOutput = 0(OFF)		Pass

Implementation



- Fast Implementation with Hardware **[Performance prediction]**
  - Advanced algorithm design using models to some functions of Core Logic
  - Algorithm Design ➔ Simulink Modeling ➔ Verification based on Simulation

Sensitivity Control

✓ Anti-saturation and automatic sensitivity control

Design → Modeling → Verification

Average Filter

✓ Moving average filter for noise reduction

Design → Modeling → Verification

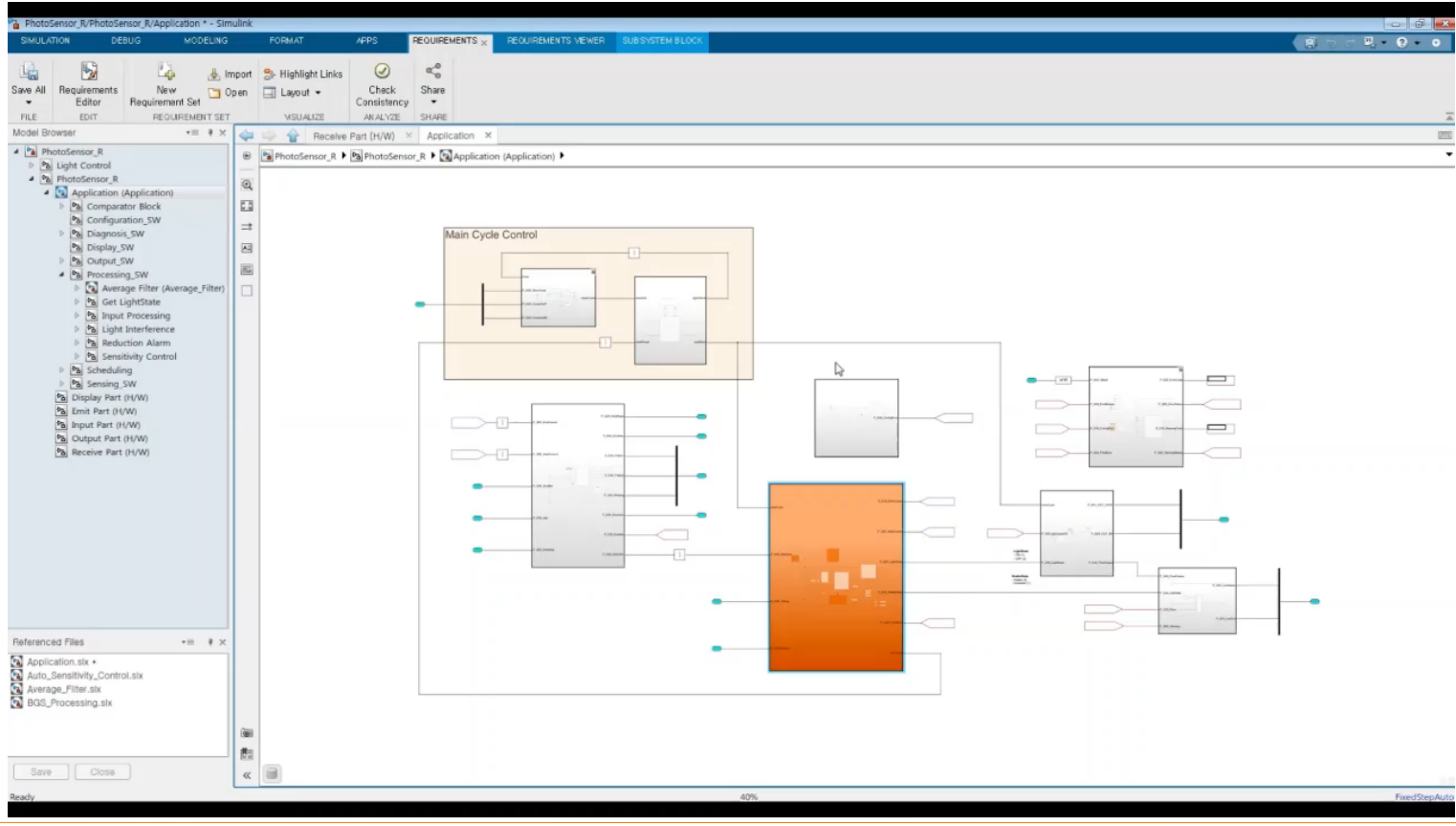
BGS Processing

✓ B.G.S processing algorithm to improve black and white error

Design → Modeling → Verification

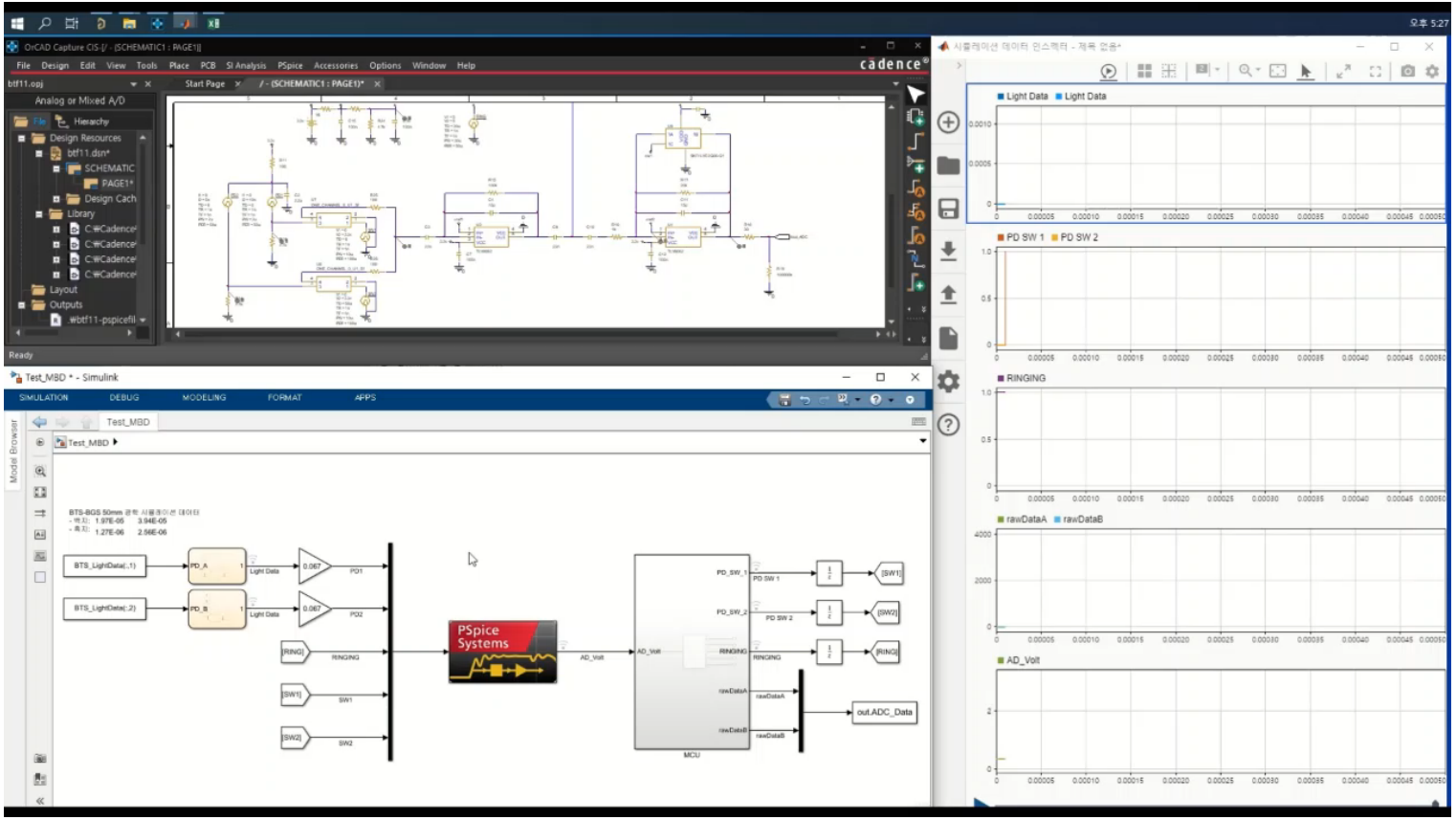
[Appendix] Action Example 2

- **Simulink – Sensitivity Control**



[Appendix] Action Example 3

◆ **Simulink - BGS Analysis 1**

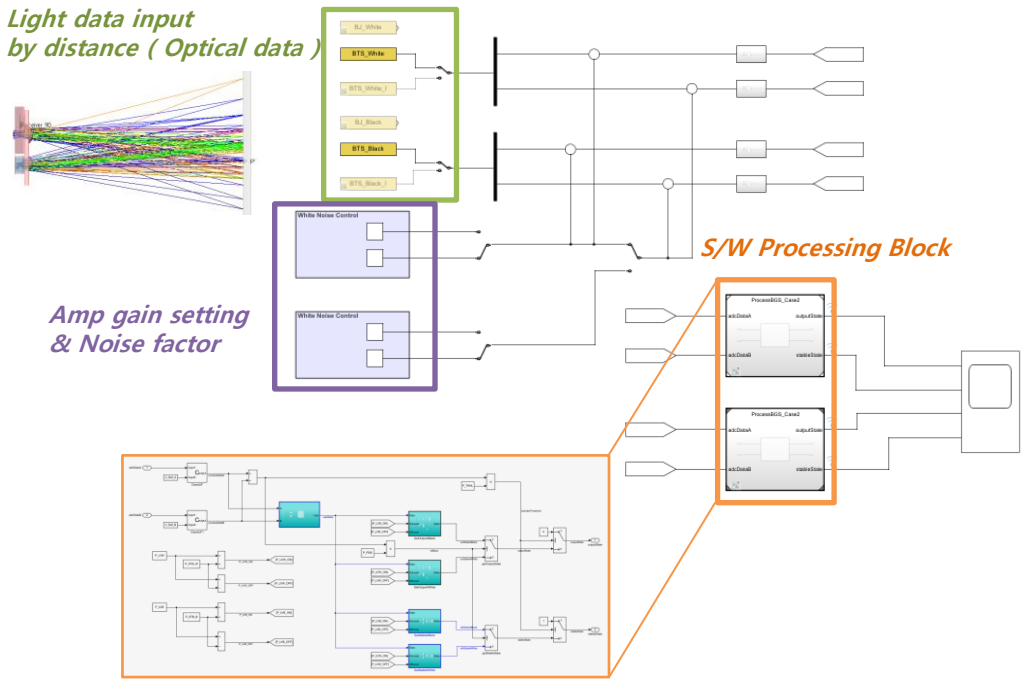


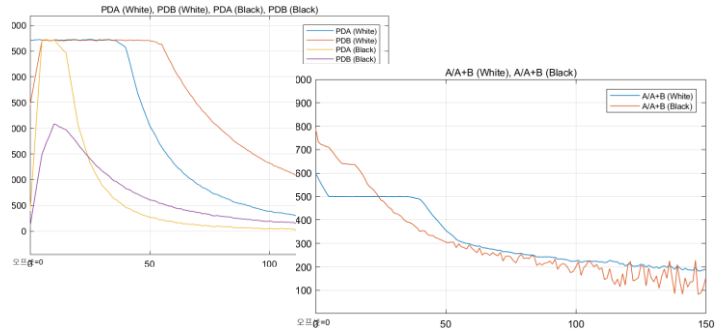
[Appendix] BGS Data Analysis

◆ Co-Simulation Extension applied

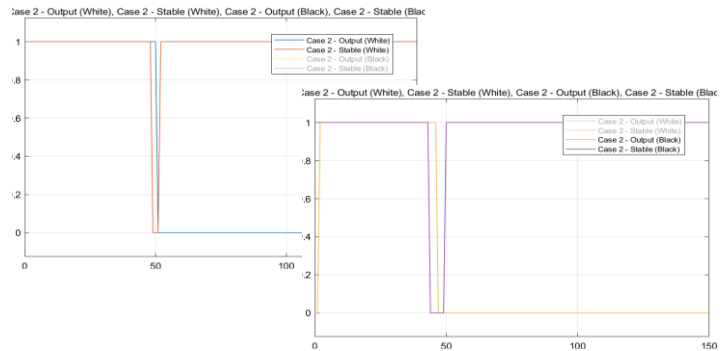
- Acquire test data by applying specified numerical parameters(Light data, Amp gain & noise, etc) to input data
- Predict the actual system performance of the built-in S/W algorithm

  (Maximum detection distance, Hysteresis distance, Black/White Error distance, Etc)





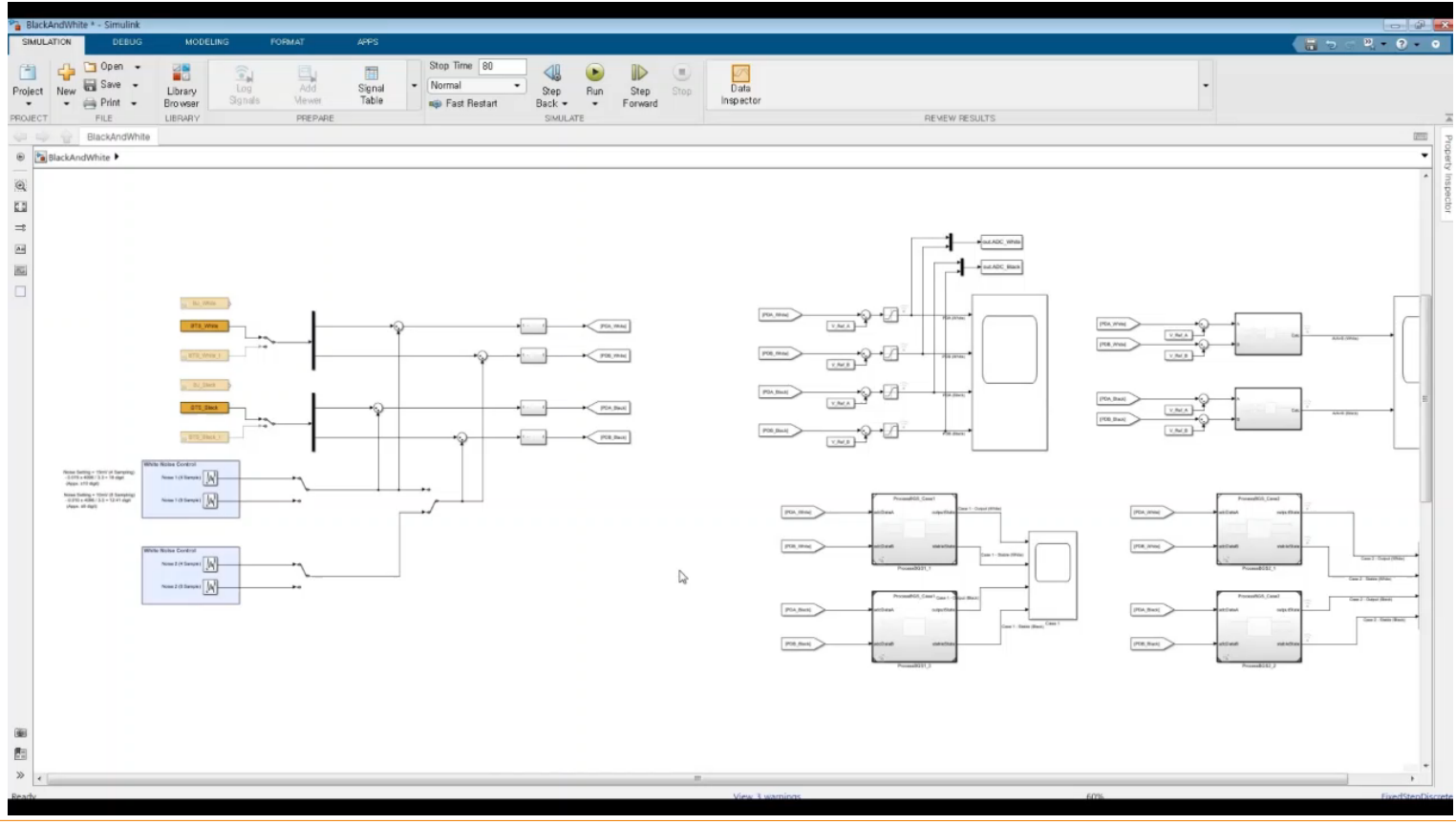
< Check processing result [ratio calculation]>



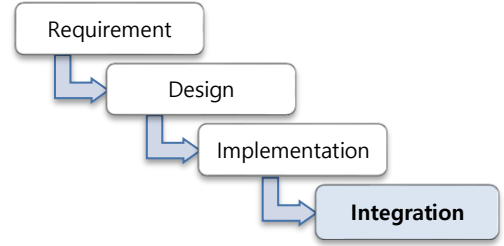
< Check output result [Detection distance]>

[Appendix] Action Example 4

- **Simulink - BGS Analysis 2**

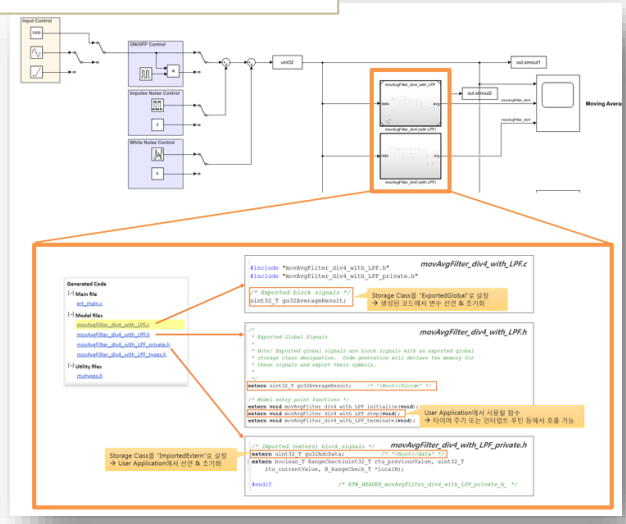


Integration and Verification

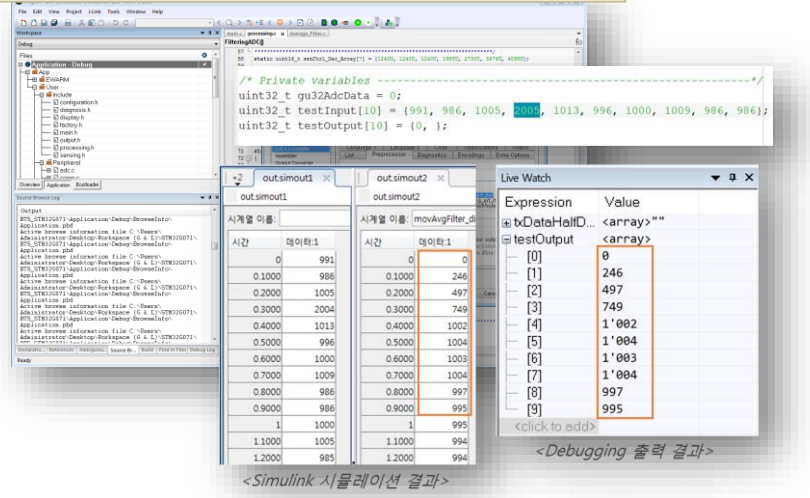


- Save the Design Time and Remove Human Errors (Using Auto-Code)
  - Auto-Code generation after verification
  - Real-Time behavior check at the Target
    ※ Reduce coding & debugging time on the real target

Auto-Code Generation

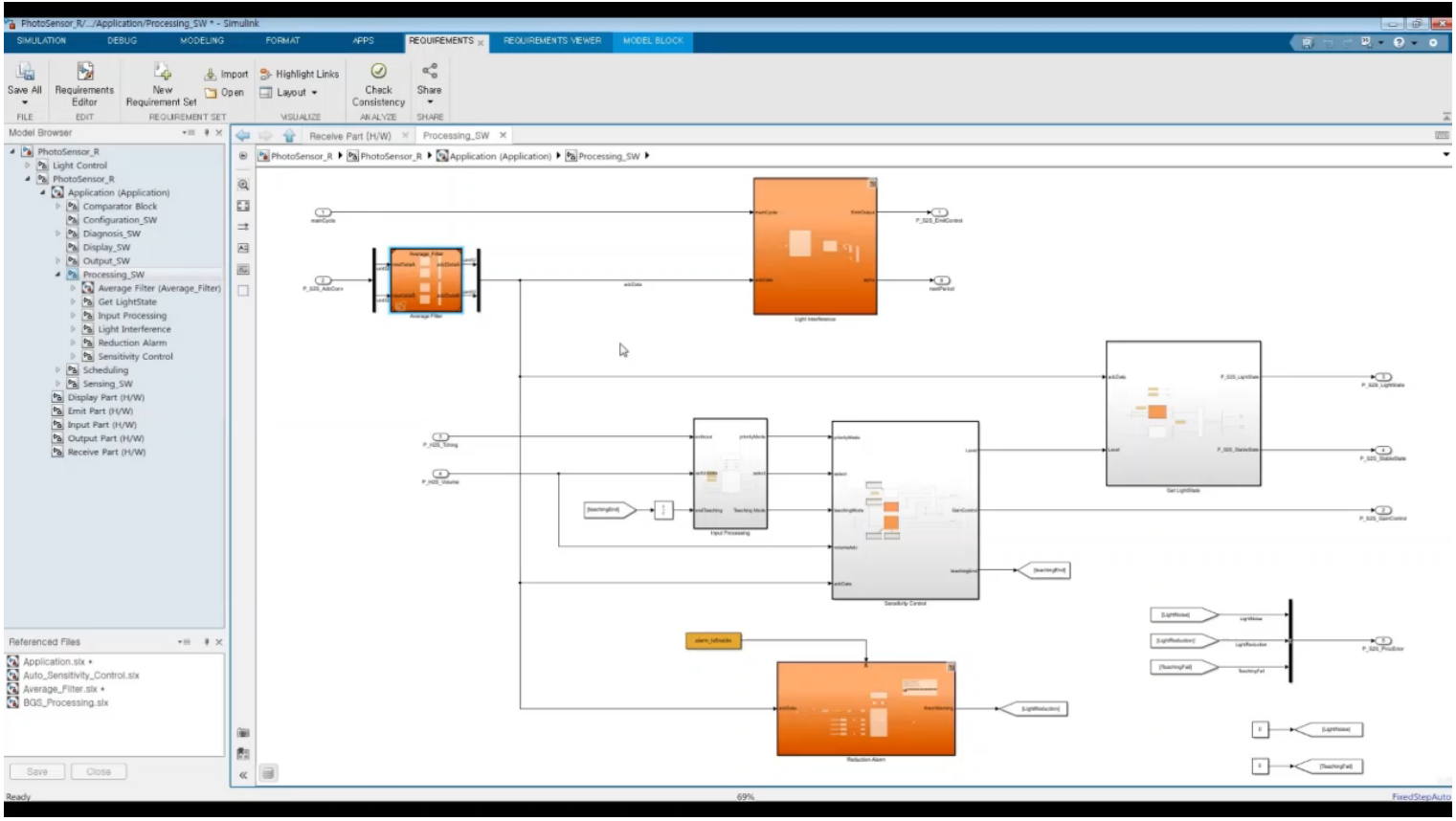


Consistency check at the Real Target



[Appendix] Action Example 5

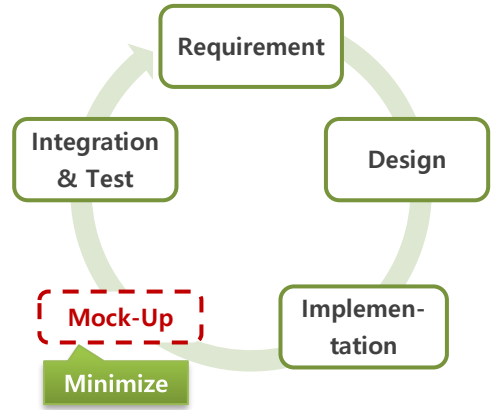
- **Simulink - Code Generation**



CONTENTS

Summary

- **Advanced data analytics** by matching analysis data
- **Easy and Fast Performance Estimation**
- **Reduction** of pre-verification period and sample production cost
- **Improved Reusability of the performance prediction model**



Simulation Light ray power&
Light distribution define

H/W Gain & Noise &
Response time define

*M/U production period for each development model : **6 months or more***

Simulation Data
(**Optical** Design)

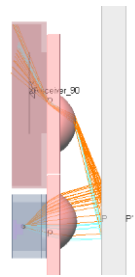
H/W **Mock-Up**
Measurement Data

Result Analysis
(S/W Design)

Simulation Data
(**Optical & H/W** Design)

Simulink Analysis
(S/W Design)

Mock-Up
Measurement Data



Performance Prediction Based on Numerical Influencer Variables
→ Reduction of development period through advanced analysis

Integrated Verification M/U Production Period : Shortened by 3 months

MATLAB EXPO

Thank you