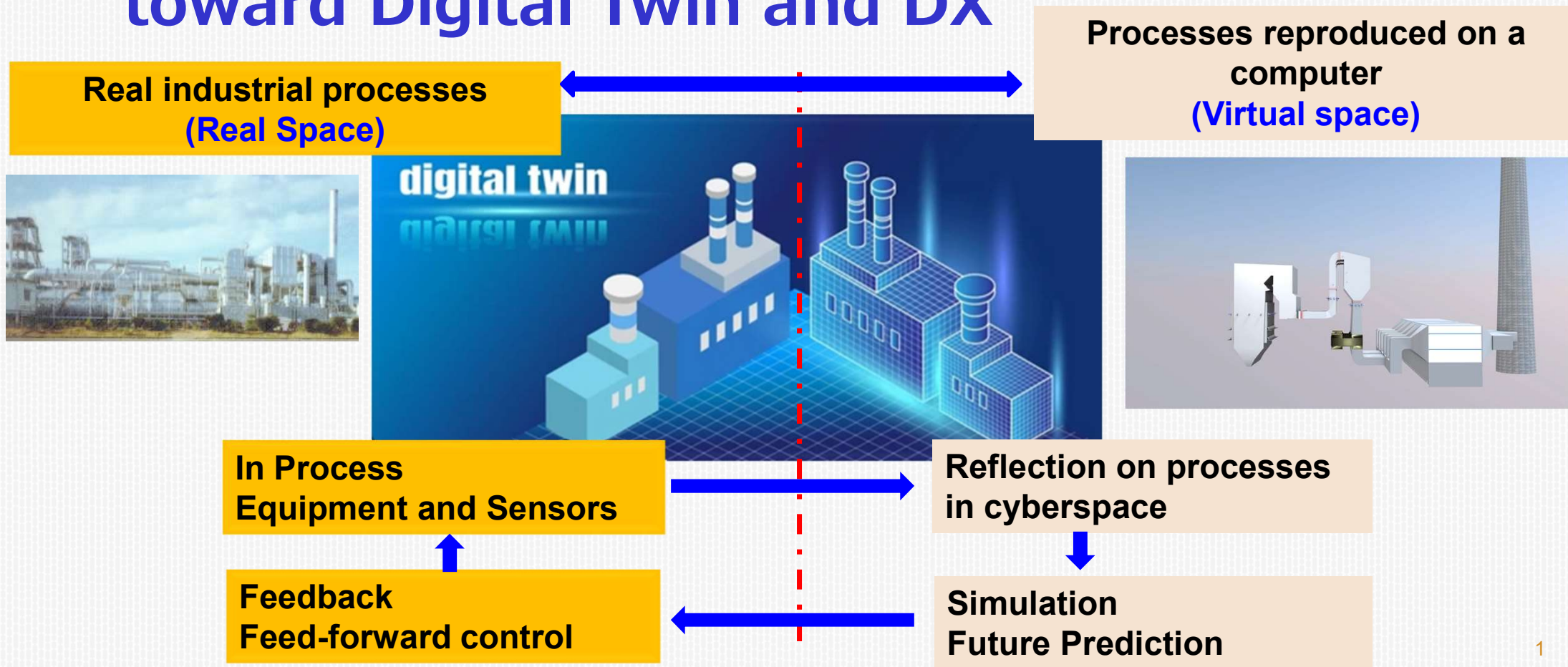


# 1. Background



## ➤ Transformation of industrial structure toward Digital Twin and DX



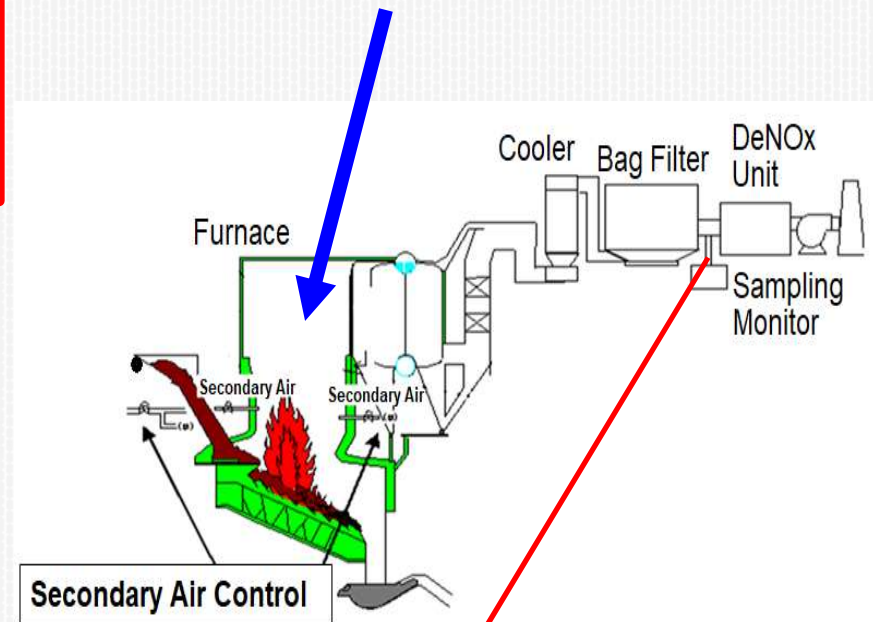
# 1. Background

Advancement of  
Technology Degree

	Process side
Present condition	<ul style="list-style-type: none"><li>● Pinpoint measurement</li><li>● Insufficient real-time performance</li><li>● Cannot measure control parameters directly</li></ul>
<b>Phase1</b>	<p><b>Upgrading of measuring instruments (on-line) (CT-TDLAS, LIBS, etc.)</b></p> <ul style="list-style-type: none"><li>● Higher accuracy</li><li>● Expansion of measurement area</li><li>● Online and real-time measurement of control parameters</li></ul>
<b>Phase2</b>	<p><b>Full automation of the entire process (DX platform)</b></p> <ul style="list-style-type: none"><li>● Integration and advancement of hardware and software</li><li>● Digital Twin System</li></ul>

## [Incinerator]

### Process reaction section



Measuring point

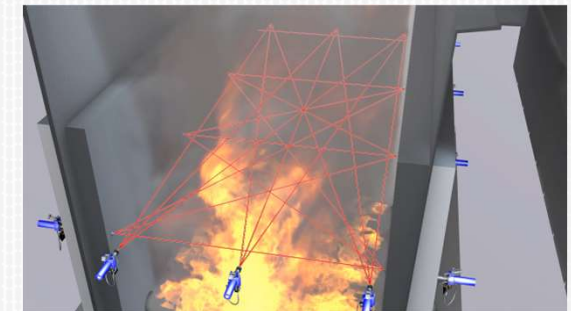
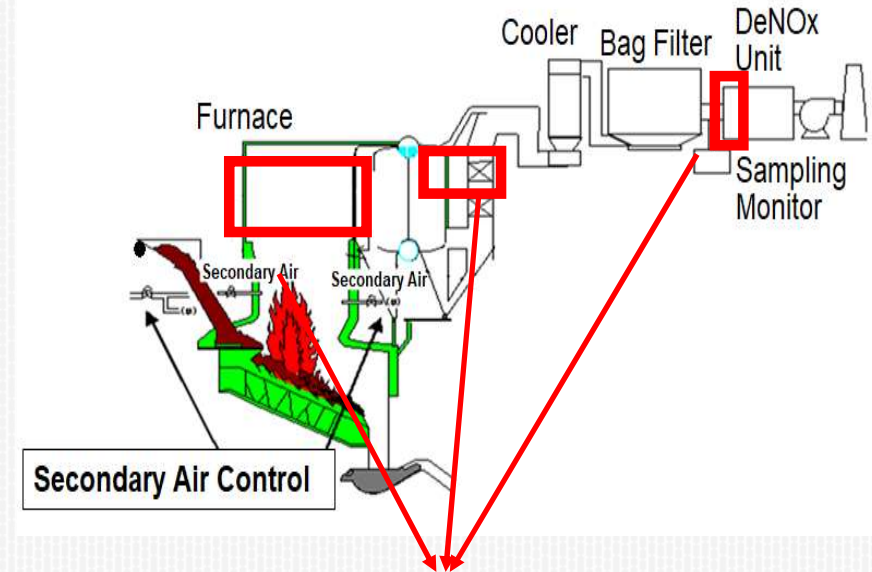


# 1. Background

Advancement of  
Technology Degree

	Process side
Present condition	<ul style="list-style-type: none"><li>● Pinpoint measurement</li><li>● Insufficient real-time performance</li><li>● Cannot measure control parameters directly</li></ul>
<b>Phase1</b>	<p><b>Upgrading of measuring instruments (on-line) (CT-TDLAS, LIBS, etc.)</b></p> <ul style="list-style-type: none"><li>● Higher accuracy</li><li>● Expansion of measurement area</li><li>● Online and real-time measurement of control parameters</li></ul>
<b>Phase2</b>	<p><b>Full automation of the entire process (DX platform)</b></p> <ul style="list-style-type: none"><li>● Integration and advancement of hardware and software</li><li>● Digital Twin System</li></ul>

## [Incinerator]

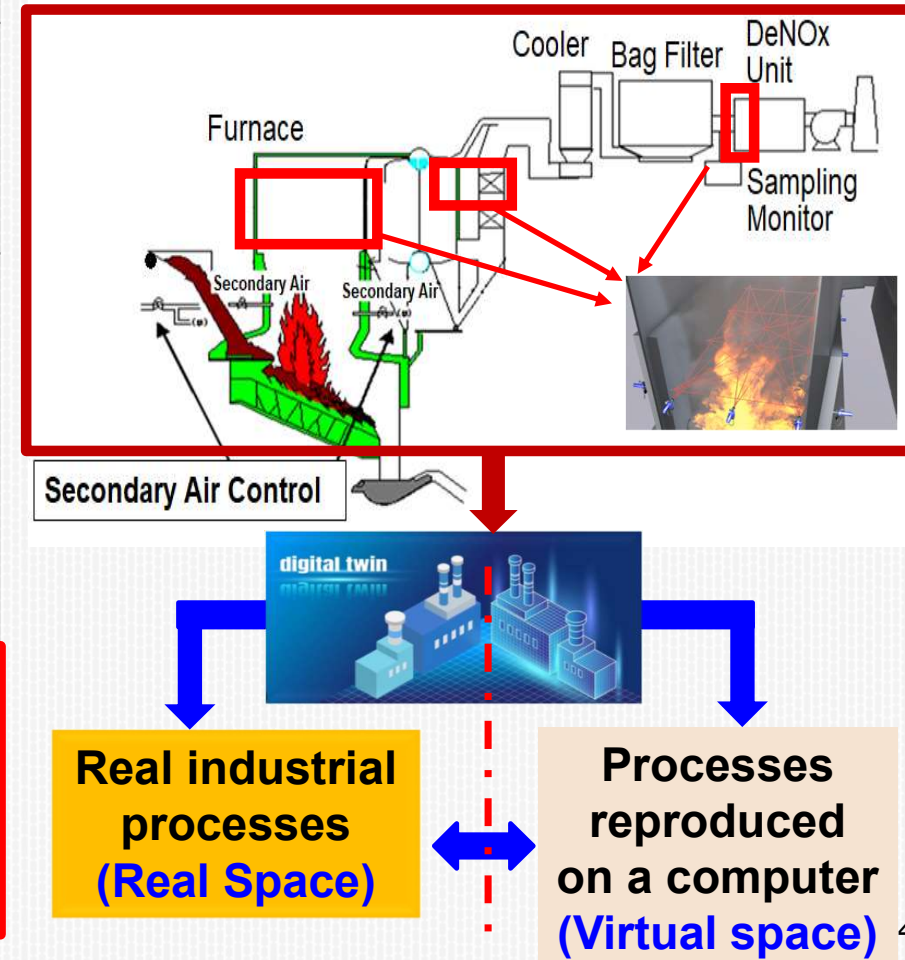


# 1. Background

Advancement of Technology Degree

	Process side
Present condition	<ul style="list-style-type: none"> <li>● Pinpoint measurement</li> <li>● Insufficient real-time performance</li> <li>● Cannot measure control parameters directly</li> </ul>
<b>Phase1</b>	<p><b>Upgrading of measuring instruments (on-line) (CT-TDLAS, LIBS, etc.)</b></p> <ul style="list-style-type: none"> <li>● Higher accuracy</li> <li>● Expansion of measurement area</li> <li>● Online and real-time measurement of control parameters</li> </ul>
<b>Phase2</b>	<p><b>Full automation of the entire process (DX platform)</b></p> <ul style="list-style-type: none"> <li>● Integration and advancement of hardware and software</li> <li>● Digital Twin System</li> </ul>

## [Incinerator]



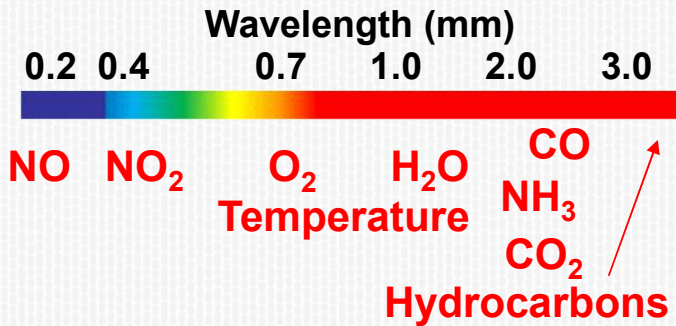


# 2. CT-TDLAS



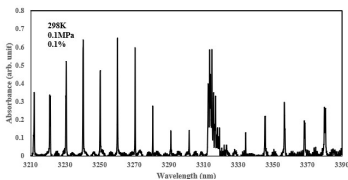
## SL&PS CT-TDLAS Systems

### Tunable Diode Laser Absorption Spectroscopy (TDLAS)

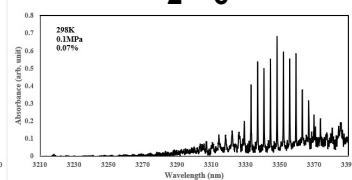


DFB lasers, DBR lasers, DFG lasers, etc.

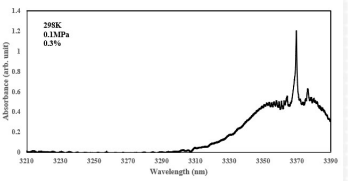
CH<sub>4</sub>



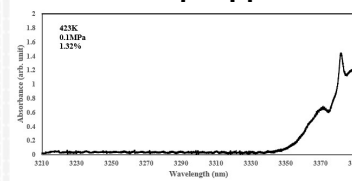
C<sub>2</sub>H<sub>6</sub>



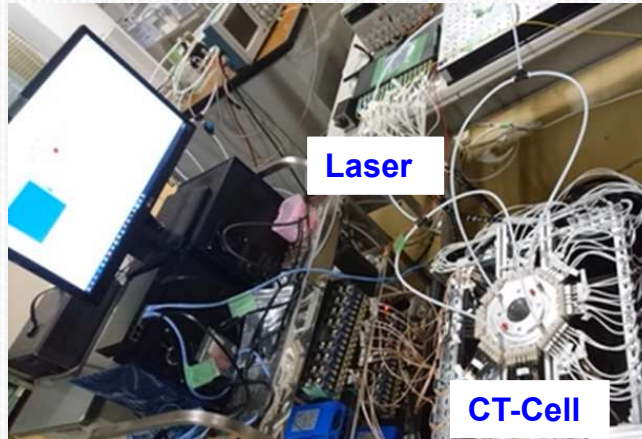
C<sub>3</sub>H<sub>8</sub>



C<sub>7</sub>H<sub>14</sub>



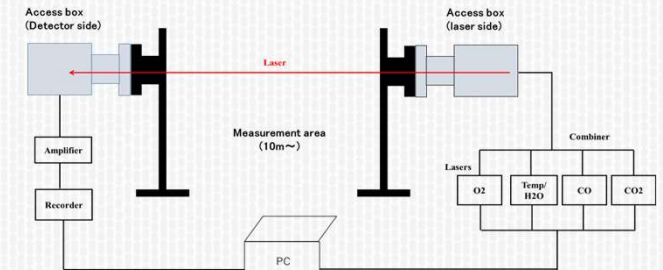
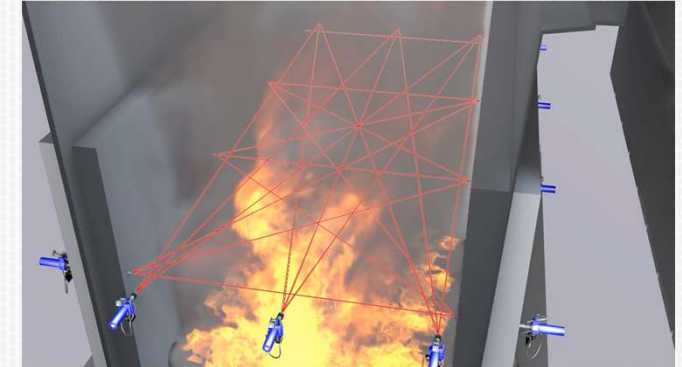
## R & D : CT-TDLAS



### Main specification

- Number of laser path : 32ch
- Target : Engine, Gas Turbine, Burner, Boiler, Semiconductor Process etc.
- Detectable species :  
Temperature (300~2000K), NH<sub>3</sub>, CO, CO<sub>2</sub>, Fuel[Hydrocarbons], NO etc.
- Pressure range : ~5MPa
- Spatial resolution :  
Less than 5 mm @ Φ70mm
- Measurement area :  
Normal size : Φ70mm
- CT-Cell Size : 250mm × 250mm × 10mm

## Process Control : SI-CT-TDLAS



### Main specification (tentative)

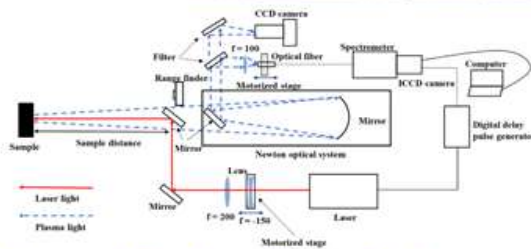
- Number of laser path : 1 - 32ch
- Target : Boiler, Iron and steel making process etc.
- Detectable species:  
Temperature (300~2000K), O<sub>2</sub>, CO, CO<sub>2</sub>, NO, NH<sub>3</sub> etc.
- Measurement area size : ~10m



# 3. LS-DP-LIBS

## SL&PS LIBS Systems

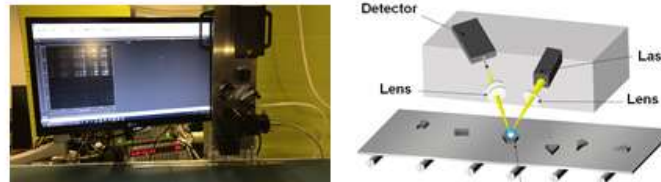
### Process Control : Remote LIBS System



#### Main specification (tentative)

- Auto-focus using 2D range finder
- 3-axis platform
- Target : Molten metals, High temperature materials, Moving objects, etc.
- Response time : 100ms –
- Target element : Fe, C, Mn, S, Si, Ni, etc.
- Detection sensitivity : Dependent on element and target

### Process Control : Built-in LIBS System

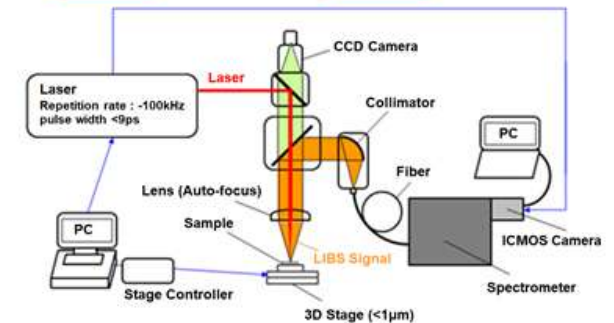
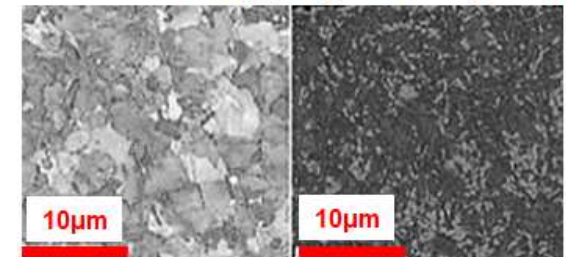


#### Main specification (tentative)

- Auto-focus using 2D range finder (Z axis)
- Laser irradiation control (X,Y axis)
- Auto-focus using 2D range finder
- Target : Metal, Non-metal, Rubber, Mineral, etc.
- Response time : 10ms –
- Target element : Fe, C, Mn, S, Si, Ni, etc.
- Detection sensitivity : Dependent on element and target

### Material Evaluation :

#### Mapping LIBS System



#### Main specification (tentative)

- Spatial resolution : 1µm –
- Mapping speed : < 25min. for 100x100
- Target : Metal, Carbon material, Battery electrode
- Target element : Fe, C, Co, Ni, Li, etc.
- Detection sensitivity : Dependent on element and target
- Display : 2D/3D Mapping, contour, etc.

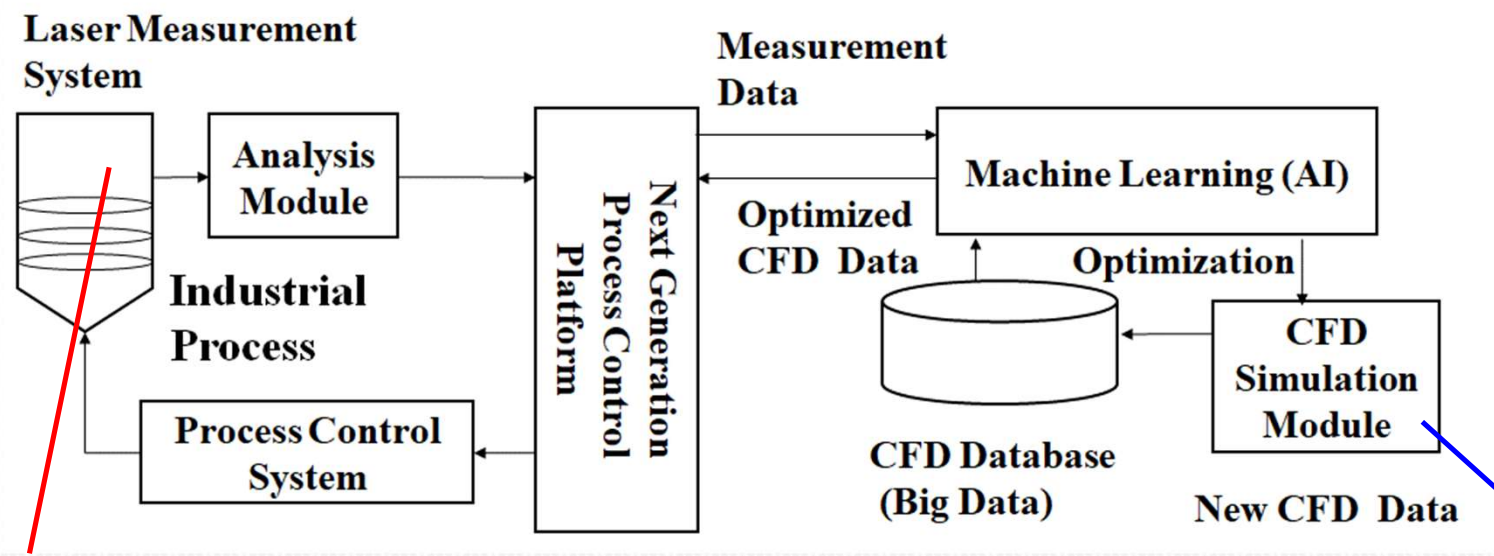
# 4. DX Platform for Digital Twin



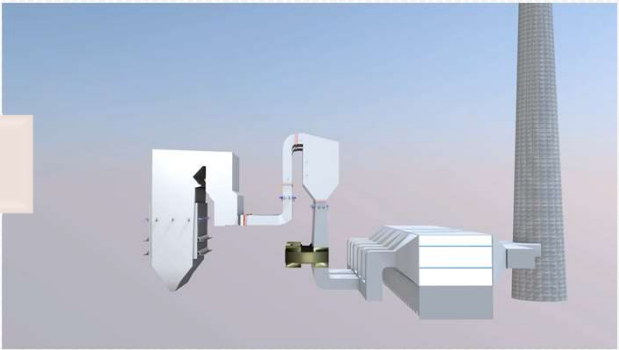
**Real**

**On-line Sensor**

**Virtual**



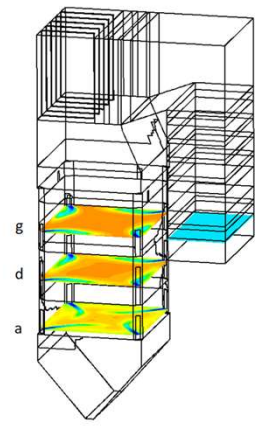
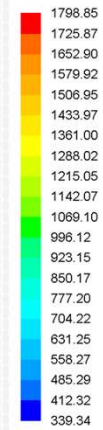
**CFD**



Temperature & Concentration

- Average
- Fluctuation
- PDF .....

Temperature[K]







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● Dynamic Mapping of Concentration & Temperature

● Laser & Plasma Foresight-Sensor

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E-mail : [info@slps.co.jp](mailto:info@slps.co.jp) WEB : <http://slps.co.jp>