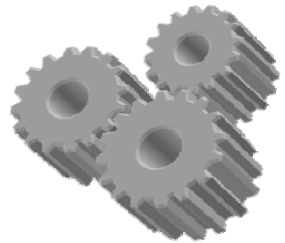




# Creative Design Education in ME, Postech: Undergraduate Students' Patents



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Global TRIZ Conference 2011  
March 10-11, 2011

# Related Courses and Events



## 1. MECH 333 System Design I

- Design Methodology, Mechanical Component Design

## 2. MECH 433 System Design II

- Senior Design Project, Introduction to Axiomatic Design(2 weeks)

## 3. MECH 465 Engineering of Creative Design

## 4. MEIE 588 Theory of Mechanical Design

## 5. Creative Design Contest

## 6. Creative Design Research Project

# ME 465 Engineering of Creative Design



Contents: TRIZ (Theory of Inventive Problem Solving)

- 40 Principles
- Technical Contradictions
- Su-Field
- ARIZ (Algorithm for Inventive Problem Solving)

Home Works: 3-4 Problems in Every Class (And Suddenly the Inventor Appeared)

Term Projects, Exams: Problems are from Industry

Field Trip

Invited Talks

History: Since 2004

Selective for Junior and Senior

# ME 465 Engineering of Creative Design



Fall semester, 2010

Term Project I: Coil Lifter [POSCO]

Term Project II: Chip on Film [Samsung Techwin]

Midterm Exam: Dish Washer [LG Electronic]

Final Exam: Fuel Cell [HMC]

Field Trip: POSCO, October 4, 2010

## Invited Talks from Industry

1. Problems in Punching Process, Mr. Y. K. Kim, Sam Sung Techwin, Sep. 12, 2010
2. Water Management and Drying Problem in Dish Washer, LG, Mr. T. H. Lee, Oct. 11, 2010
3. What are good inventions and patents? Mr. D. M. Kim, Nov. 8, 2010.
4. Fuel Cell for Automotive, HMC, Dr. Y. C. Yang, Nov. 17, 2011
5. Innovation in Iron Making – FINEX Technology, POSCO, Dec. 1, 2010

# MEIE 588 Theory of Mechanical Design



Contents: Axiomatic Design

- Independence Axiom
- Information Axiom
- Single/Multi Functional Required Design
- Applications

Term Projects, Exams: Problems are from Industry

History: Since 2002

Selective for Graduate and Senior Students

# Creative Design Contest



Eligibility: Undergraduate Students of Postech and KAIST

Area: Creative Design, Theory of Creative Design

Evaluation:

- What is main difference from conventional design?
- What kind technical problem is overcome?
- What kind physical (scientific) contradiction is solved?
- Is it useful?
- Is it realistic?

Prize: 5 Million Korean Won for Grand Prix; 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>

History: Since 2006

# Creative Design Research Project



Eligibility: Undergraduate Students of Postech

Problems are from Industry

Period: 8 Weeks during Winter Vacation

Stipend: Dormitory and Personal Expenses

Prize: 3 Million Korean Won for Grand Prix; 2<sup>nd</sup>, 3<sup>rd</sup>, 4<sup>th</sup>

History: Since 2008 Winter Vacation



# Undergraduate Students' Patents



## MECH 465 Engineering of Creative Design

No.	Name	Name of the Invention	Remarks
1	I. Bae	Carrier Module of Test Handler for IC Package	Patent Registered
2	S. Lyu, B. Kim S. Cho	Welding Device	Patent Registered
3	S. Lee	Thrust Device under Water (1)	Patent Registered
4	S. Cho, H. Yu	Thrust Device under Water (2)	Patent Registered
5	I. Kim, S. Lee	Device for Processing of Food Wastes (1)	Patent Registered
6	J. Park	Device for Processing of Food Wastes (2)	Patent Registered
7	S. Cho	Device for Clamping Fuel Cell Stack	Patent Registered (Korea, USA), Patent Pending (Japan, China, Germany)
8	H. Kim, B. Park	Dummy Bar Coolant Removing Dummy Bar Head Easily	Patent will be Applied
9	Y. Hong S. Hwangbo	Dummy bar head Replacing Damaged Parts Easily	Patent will be Applied
10	J. Jang	Ice bank with Asymmetric Structure	Patent will be Applied
11	S. Lee	Book Scanner Turning Pages Easily	Patent will be Applied
12	B. Park, J. Kim S. Yoon, J. Lim H. Seong	Dehydrating Hole to Prevent Cloth-damage	Patent will be Applied
13	Y. Kim, M. Cho	Dehydrating Surface of Washing Machine to Prevent Cloth-damage	Patent will be Applied
14	S. Seok	Dehydrating Surface of Washing Machine to Prevent Cloth-damage	Patent will be Applied
15	J. Kim	A Vibration Decreasing Device for Washing Machine	Patent will be Applied
16	S. Lee	A Structure of Legs for Vibration Decreasing in a Washing Machine	Patent will be Applied
17	B. Kim	Valve Plate for a Sliding Gate	Patent will be Applied
18	S. Lee, S. Jeong	Ice bank with Built in Ice-Making System	Patent will be Applied

# Undergraduate Students' Patents



## 2008 Creative Design Research Project

No.	Name	Theme	Summary of Patent	T.A.
1	C.Choi	Development of Safety Valve for Low-pressure Gas Pipe	Configuration of Safety Valve System By Wireless LAN	D.Kim
2	C.Choi	Preventing Splattering with EGL(Electrolytic Galvanized Line) Coating Liquid	Preventing Splattering Using Different Surface Properties	D.Kim
3	C.Choi	Preventing Splattering with EGL(Electrolytic Galvanized Line) Coating Liquid	Preventing Splattering by Blowing	D.Kim
4	J.Yun	Measuring the Thickness of the Cooper Stave in Blast Furnace	Measuring the Thickness of the Stave Using Two kinds of Resistors	S. Lee
5	J.Yun	Measuring the Thickness of the Cooper Stave in Blast Furnace	Measuring the Thickness of the Copper Stave by Adding Cable and Insulator	S. Lee
6	J.Yun	Preventing the Whirling of BIC REELER in 2 <sup>nd</sup> Wire-rod Factory	Seperation of Fixing Structures for Ring and Wire-rod	C. Lee
7	J.Yun	Preventing the Whirling of BIC REELER in Wire-rod Factory	Seperation of Fixing Structures for Ring and Wire-rod	C. Lee
8	J.Suh	Development of Safety Valve for Low-pressure Gas Pipe	Seperation of Pressure Detecting and Exhausting Gas(Using Buoyancy)	D.Kim
9	J.Suh	Development of Safety Valve for Low-pressure Gas Pipe	Seperation of Pressure Detecting and Exhausting Gas(Using Bypass)	D.Kim
10	J.Suh	Preventing Defects of Coke Oven Door Latch	Enhancement of Accuracy of Latch by Reducing Friction	C. Lee
11	S.Lim B.Park	Apparatus for Sensing Bad Rotation of GUIDE ROLLER in Deadweight and Finishing Entrance	Sensing Rotation of Guide Roller Using Internal Self-generating	C. Lee
12	S.Lim	Preventing Defects of Coke Oven Door Latch	Measuring Angle of Latch by Laser	C. Lee
13	S.Lim	Preventing Defects of Coke Oven Door Latch	Fixing Latch Using Rack and Pinion	C. Lee
14	D.Kim	Measuring the Thickness of the Cooper Stave in Blast Furnace	Measuring Depth of Cooper Stave Using Resistor	S. Lee
15	B.Park	Detecting a Replace Period of a Belt Conveyer	Measuring the Wear Using Color Changes	C. Lee
16	B.Park	Detecting a Replace Period of a Belt Conveyer	Measuring the Wear Using Magnetic Changes	C. Lee

# Undergraduate Students' Patents



## 2009 Creative Design Research Project

No.	Name	Theme	Summary of Patent	T.A
1	D.Kim	Development of Supply Regulation Equipment in Premelt Pot	Apparatus for controlling the Outflow by Adjusting Melting Surface Level	S.Lee
2	H.Lee	Removal of Powdery Scale on the Top Side and Bottom Side of Hot Strip	Removal of Scale on the Surface of Hot Strip Using Asymmetric	S.Lee
3	S.Yu	Deduction of a New Method for Detecting HF Tube Weld Seam	Detecting HF Tube Weld Seam by Image Processing	C.Lee
4	J.Yun	Development of Novel Coating Roll	Coating Roll with Screws to Change easily	D.Kim
5	J.Yun	Development of Novel Coating Roll	Development of Design of Coating Roll Using Steel plate	D.Kim
6	H.Cho	Development of device for CGL Air Knife Lip Cleaning	Air knife lip cleaning by Controlling Wettability	S.Lee
7	S.Lim	Preventing Forming Zn Ash in Snout	Removing Zn Ash and Inhibiting Zn Ash Generation Using Partitions	C.Lee
8	J.Kim	Deduction of a New Method for Detecting HF Tube Weld Seam	Detecting Method for Heat Tube Weld Seam Using Fluorescent marking	C.Lee
9	S.Kim	Deduction of a New Method for Detecting HF Tube Weld Seam	Detecting Method for Heat Tube Weld Seam Using Dial Gage	C.Lee
10	S.Kim	Preventing Forming Zn Ash in Snout	Separating Strip and Zn Ash by Installing the Duct in Snout Leading Zn Ash to the Cooling Part	C.Lee
11	T.Kim	Identifying the Cause of Generating Tar in COG Pipe of Heating Furnace	Method of Prevention of Corrosion of the inside of Pipe by Condensing COG Gas and Using Air Mixture	D.Kim
12	J.Yun	Development of Novel Coating Roll	Adhesion Using Magnetic Force and Transformation of Wire Structure	D.Kim
13	Y.Kim	Improving Cooling Efficiency of Sintered Ore Cooler	Improving Cooling Efficiency of Sintered Ore Cooler by Changing the Shape of Air Duct	D.Kim
14	Y.Kim	Improving Cooling Efficiency of Sintered Ore Cooler	Improving Cooling Efficiency of Sintered Ore Cooler by Using Water Spray	D.Kim
15	S.Park	Development of CGL Air Knife Lip Cleaning Device	Improving Air Knife Lip Cleaner Using Symmetric Structure	S.Lee
16	S.Lee	Removal of Powdery Scale on the Top Side and Bottom Side of Hot Strip	Removal of Powdery Scale on the Top Side and Bottom Side of Hot Strip Using Cathodic Protection	S.Lee
17	H.Jeon	Preventing Releasing and Width's Decreasing When Winding of Hot Steel Strip (DC Tension Control)	Improving the Winding System Using Electromagnets	S.Lee
18	S.Cho	Method for Cooling coils Uniformly in the Coil Yard	Cooling System with Differential Distribution of Flow by Coolant's Viscosity	C.Lee

# Conclusions

## 1. Advantages of the lecture cooperating with the industry

First, We teach students the current state of industry

Second, the lecture provides students with opportunities to exert their creativity

Third, the company can solve the problems by innovative ideas suggested from students

## 2. The lecture, which teaching the methodology to improve the student's creativity and giving them unsolved problems as assignments, is very effective

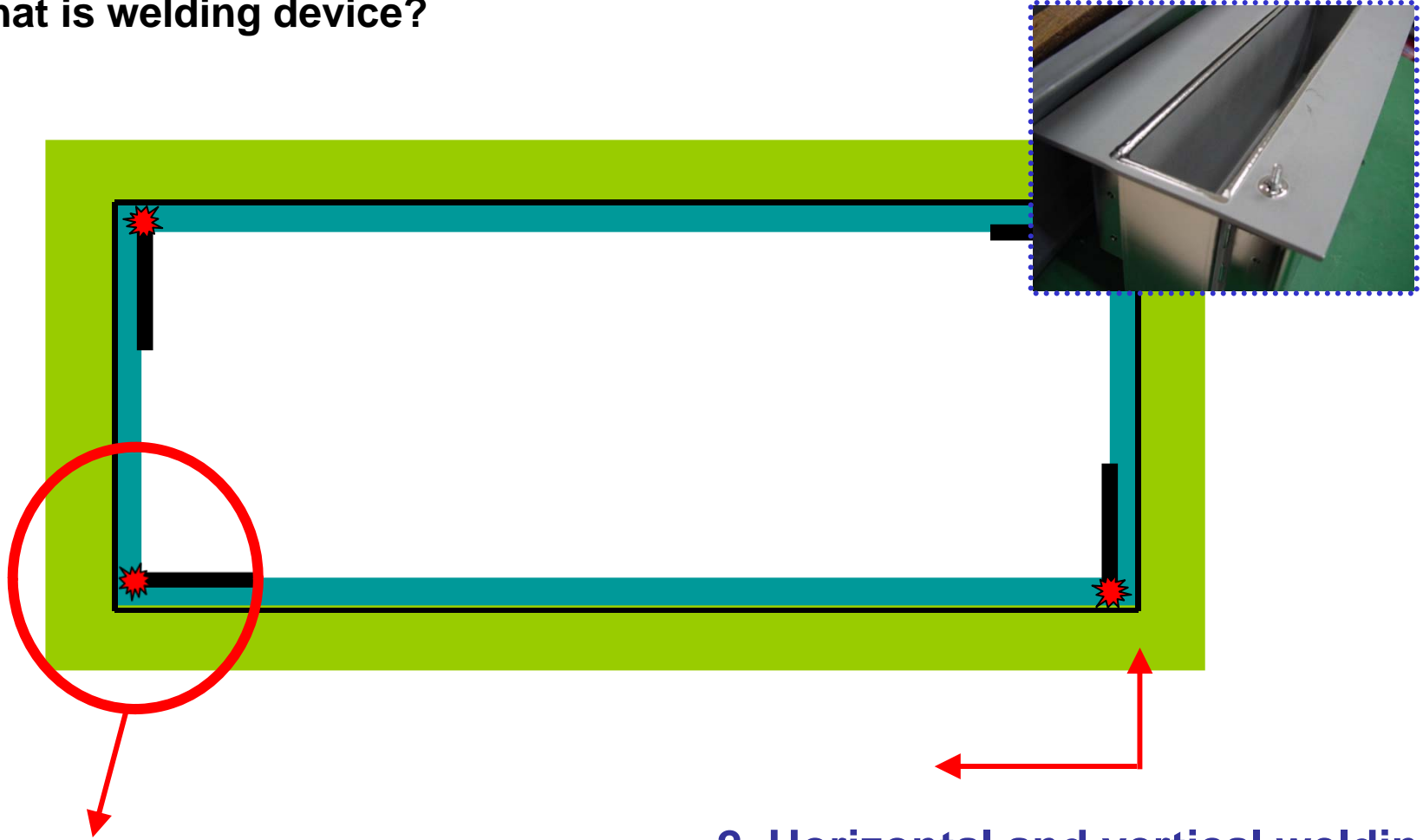


# Example of Undergraduate Students' Patents

# Two-Dimensional Welding Device



◆ What is welding device?



1. Rectangular at the corner

2. Horizontal and vertical welding

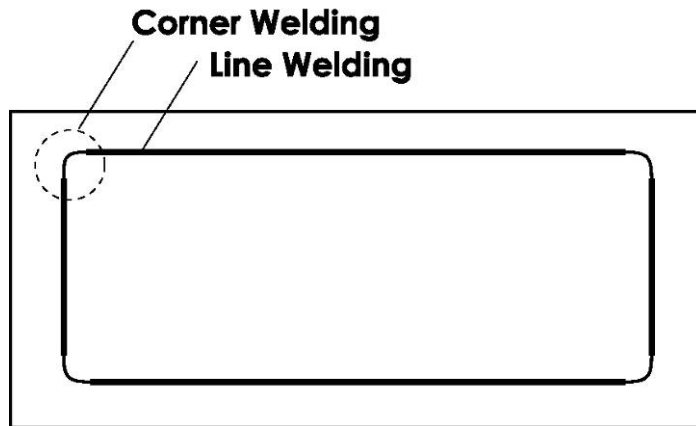


# Two-Dimensional Welding Device



## ◆ Welding of a rectangular chamber

- Welding by a linear device
- Time and money waste for the corner welding
- Low quality welding



**Welding  
by machine**



**Welding  
by hand**

# Two-Dimensional Welding Device



## ◆ Functional Requirements

- Rectangular welding at the corner
- Automatic welding with both direction
- Using 1 motor for welding. (low expenses) - restriction

## ◆ Technical contradiction (1 motor case)

- A motor rotates a curve but linear movement is required
- Rectangular welding by rotational movement of a motor.



# Two-Dimensional Welding Device



## ◆ 40 Principles

### - 10. Preliminary Action

- A. Do it in advance
- B. Set the object at the best position and decrease time waste for supply

### - 14. Curvature Increase

- A. Change linear shape to curved shape
- B. Change linear movement to rotation movement
- C. Use a roller, a ball and a screw

### - 15. Dynamicity

- A. Improve characteristics of an object to provide optimal performance
- B. Separate the objects to move relatively
- C. Move the object

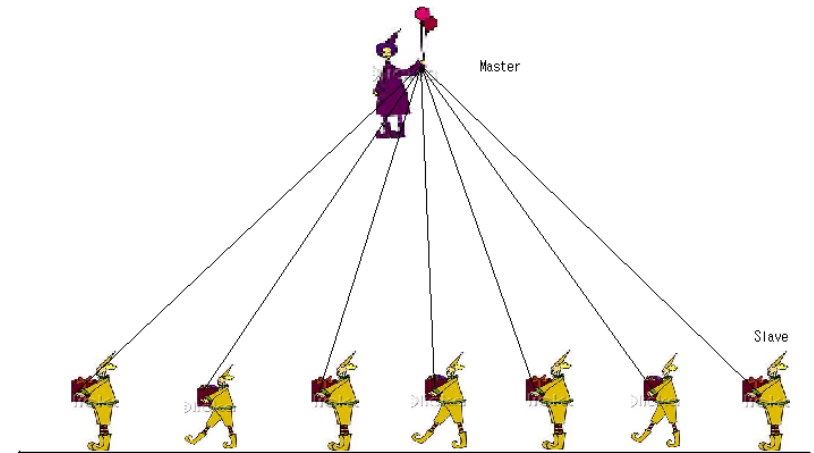
# Two-Dimensional Welding Device



## ◆ Smart Little People Modeling

- Assume a little people consist of device
- Find a solution by these people
- Find a design variable for the solution

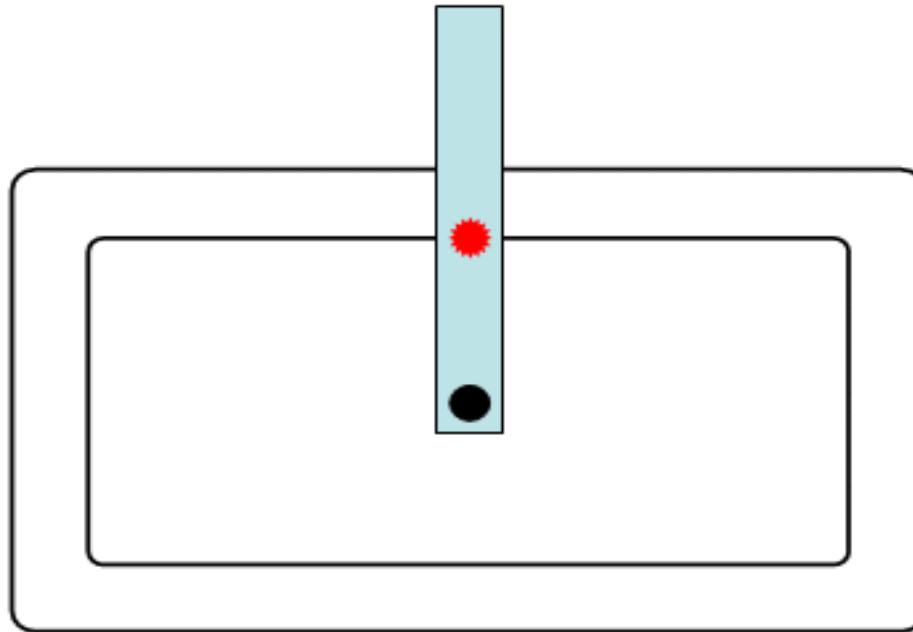
- Master at the center → control a string length (motor)
- Slave at the welding device → Move grasping a string (welding)



# Two-Dimensional Welding Device



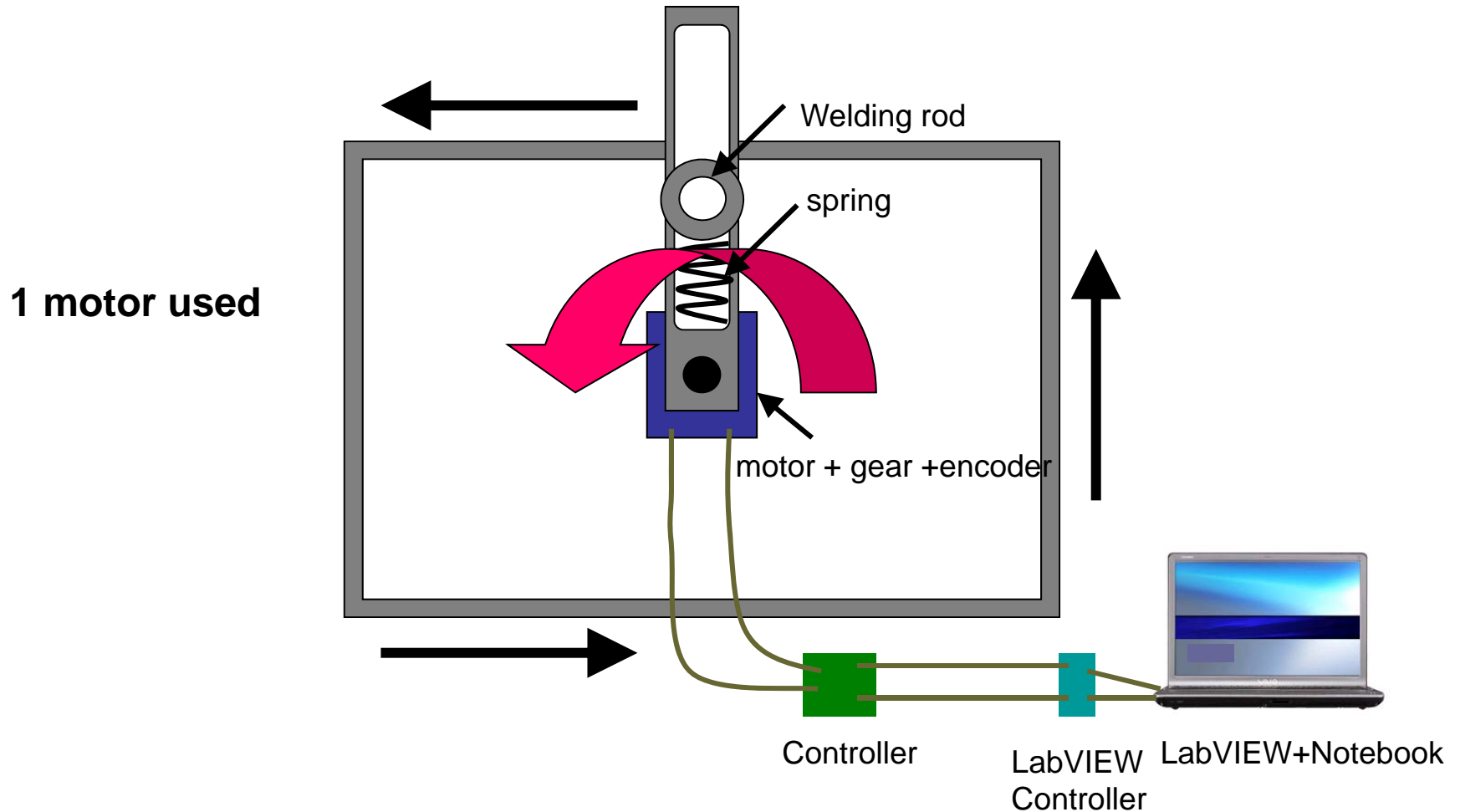
## ◆ Conceptual illustration for a new idea



# Two-Dimensional Welding Device



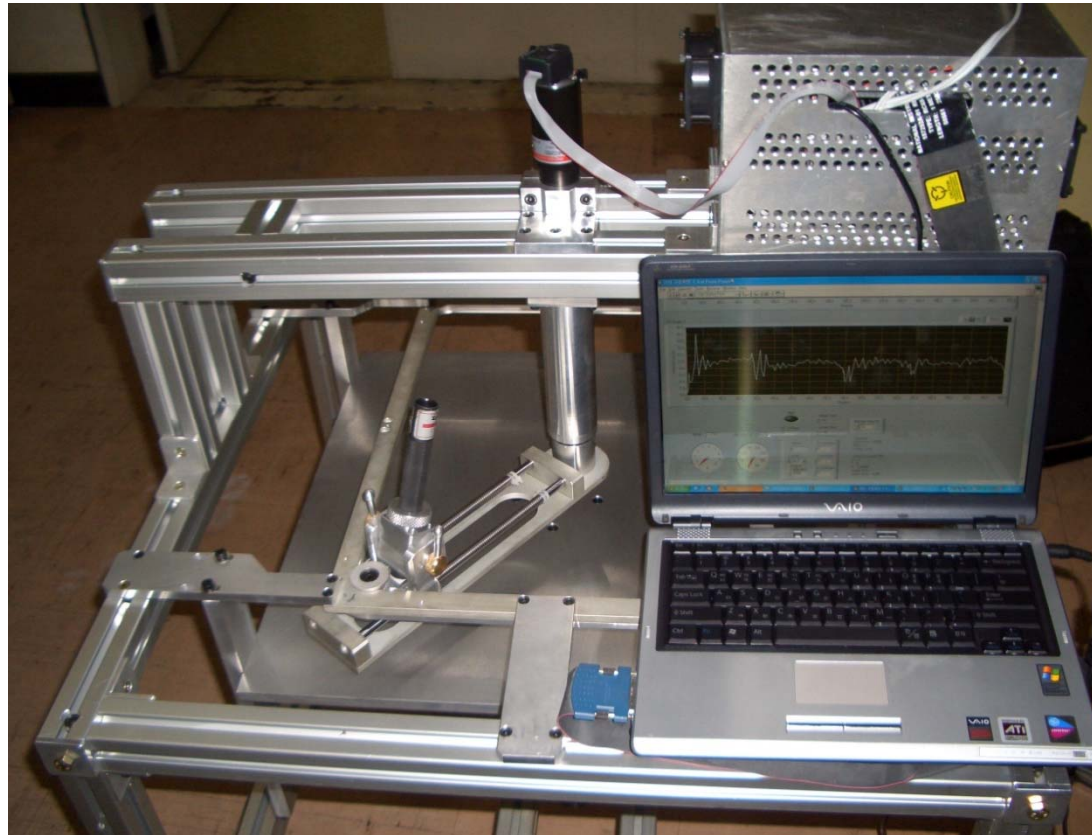
## ◆ Detail conceptual design for a pilot



# Two-Dimensional Welding Device



## ◆ Pilot



# Two-Dimensional Welding Device



## ◆ Automatic welding device



## ◆ Test result

