Image Processing and Interactive Arts - Industrial and Students Projects

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2016.3.2

www.sues.edu.cn
Image Sensor

lb@dongseo.ac.kr
Camera
Image Sensor

- A device that converts an optical image to an electric signal
- Charge-Coupled Device (CCD)
- Complementary Metal–Oxide–Semiconductor (CMOS)

http://en.wikipedia.org/wiki/Active_pixel_sensor
http://astro.kias.re.kr/~hshwang/ccd.htm
Color Sensor

- Bayer sensor – Demosaicking
- Foveon X3 sensor
- 3CCD

The Bayer arrangement of color filters on the pixel array of an image sensor. Each two-by-two cell contains two green, one blue, and one red filter.


Sigma Corporation announces two new cameras using the Foveon 14.1 Megapixel X3 sensor.

Check out the Sigma press releases for the SD15 and for the DP2!
Industrial Projects with Image Sensor

lbg@dongseo.ac.kr
The Leader of 3D Solder Paste Inspection

Parmi is a world leader in 3 dimensional inspection for printed solder paste on PCB. We provide a series of products to meet various customer needs. Top level quality and surprisingly high inspection speed of our machines are based on the unique 3D RSC (Range scan camera) sensor.
Multilevel B-spline
An Efficient Scattered Data Approximation Using Multilevel B-splines Based on Quasi-Interpolants
The 5th International Conference on 3-D Digital Imaging and Modeling
Byung-Gook Lee, Joon Jae Lee, Jaechil Yoo
lbg.jlee@dongseo.ac.kr

B-spline approximation
- Global approximation
- Quasi-interpolants

Multilevel B-spline approximation

Applications
- Surface approximation with scattered data
- Image representation and compression
- Filling holes in Range data

B-spline approximation

Let \( \Phi = \{ \phi_i \}_{i=1}^n \) be a control lattice overlaid on a domain \( \Omega \).

Weights: uniform data case

Given a function \( f \), the basic problem of spline approximation is to determine B-spline coefficients \( \{ c_i \} \) such that

\[
 f(x) = \sum_{i=1}^{n} c_i \phi_i(x)
\]

is a reasonable approximation to \( f \).

We fix \( x \) and propose the following procedure for determining \( c_i \):

1. Choose a local approximation method \( \Phi_\mathbf{L} \) with the property that it respects the interior of the support of \( \phi_i \) for \( 1 \leq i \leq n \). Denote the restriction of the space \( \Phi_\mathbf{L} \) to the interval \( I \) by \( \Phi_\mathbf{L}|_I \).

2. Choose some local approximation method \( \Phi_\mathbf{L} \) with the property that \( \Phi_\mathbf{L}|_I = \Phi_\mathbf{L} \) for all \( g \in \Phi_\mathbf{L} \).

3. Let \( \mathbf{x}_0 \) denote the restriction of \( \mathbf{x} \) to the interval \( I \). Then there exist B-spline coefficients \( \{ c_i \} \) such that

\[
 f(x) = \sum_{i=1}^{n} c_i \phi_i(x)
\]

is a reasonable approximation to \( f \).

Multilevel B-spline approximation

The algorithms run in a multiresolutional setting over uniform partitions such that the final surface \( f \) is composed of a sequence of surfaces of dyadic scales.

\[
f(x) = \sum_{i=1}^{n} c_i \phi_i(x)
\]

where \( \phi_i \) is a function such that \( \phi_i(x) \) is a piecewise polynomial of degree \( d \), and \( c_i \) are the coefficients of the spline.

Multilevel B-spline approximation

Applications

Table 1. Approximation error results

<table>
<thead>
<tr>
<th>Level</th>
<th>( \epsilon )</th>
<th>( | f - f_n |_\infty )</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1e-3</td>
<td>2.5e-3</td>
</tr>
<tr>
<td>2</td>
<td>1e-4</td>
<td>5.0e-4</td>
</tr>
<tr>
<td>3</td>
<td>1e-5</td>
<td>1.0e-4</td>
</tr>
<tr>
<td>4</td>
<td>1e-6</td>
<td>2.0e-5</td>
</tr>
</tbody>
</table>

We used three data sets of M100, M630 and R150, where M100 and M630 are small and large data sets, which consist of 100 and 630 points, respectively. We uniformly sampled 7 and 10 in 15 data points, respectively, while the others were randomly sampled. And R150 points were totally randomly sampled.

To demonstrate the time efficiency of the proposed method, we calculate time as the sample points increase from 100 to 1000 by 100 steps where the number of control points at initial level is 7×7 and four levels are performed. Fig. 4.7 shows the relation between the size of the coefficient matrix and the time consumed. The total time complexity is \( 0(n^3 + n^2 m) \) because we have to store all the control coefficients in the matrix. But if an adaptive control lattice hierarchy is used, a control lattice can be reduced by a simple set of necessary control points.

A: Original range data B: Multilevel B-spline approximation • A real range data acquired from 3D scanner is used to prove the efficiency of the proposed algorithm. Fig. 9 shows a real data with many holes in their region due to low reflection of laser where the size of data is 320×220 and the pose intensities depict depth values. The uniform hole filling-based multilevel approximation is then used to fill these holes. As shown in Fig. 13, the method generates good approximation and smooth surface, filling missing data points by interpolation property where the algorithm generates fine level with initial full control points.
Multilevel B-spline
3D Scanning
Laser scanning
4DCulture I-View

Scan data modify
Texture mapping
Smoothing & optimize

Measurement
Measuring & Report
Section diagram

Surface model
Exchange Surface Model
Extract Features
Export Maya, 3DMax

Application
Toy & Culture industry
Recovery cultural assets
Flat Panel Display Defect Detection

Work flow

FPD Data
Preprocess
Feature extraction
3D Surface Approximation
Wavelet Transform
Postprocess
3D Surface Approximation
- Polynomial
- B-spline
- Psi basis (edge enhancement, CASD2105 yoon)
- Exponential spline
- Global vs Local
- Cross Validation
- Thresholding (height vs area)

BLU 엘룩불량 377_6317.bmp
Cubic B-spline approximation

Number of control points

Difference image

Mura detection filter
A WAVELET BASED FLAT PANEL DISPLAY DEFECT DETECTION

WavE 2006, July 10-14, 2006, EPFL Lausanne, Swiss Byung-Gook Lee, Joon Jae Lee, Hoon Yoo, Yeon Ju Lee, Jungho Yoon lbg@dongseo.ac.kr http://kowon.dongseo.ac.kr/~lbg/

Objectives
- Defect Detection of Flat Panel Display

Problems
- Uneven illumination due to self radiation
- High frequency noise inherent in images

The Proposed Method
- Surface approximation based approach using wavelet multiresolution

Uneven illumination

Idea for uneven illumination compensation

Wavelet Representation

Elimination parts for compensation

Compensation approach

\[ F(o) = ((HH1 + HL1 + LH1) + (HH1 + HL1 + LH1)) \]
\[ (LL1 + HH1 + HL1 + LH1) \]
\[ F(o) = HH1 + HL1 + LH1 \]
\[ F(o) = LL1 \]
\[ F(o) = (HH15 + HL15 + LH15) + (HH15 + HL15 + LH15) + (HH15 + HL15 + LH15) \]
\[ F(o) = F(o) - F(o) - F(o) - F(o) \]

Compensated image result

Performance

- Mathematical analysis using surface approximation for illumination compensation
- Performance
  - Accuracy, Speed, Reliability
  - General method for various defect types

Conclusion and further research
Keypad Inspection System of Cellular Phone

Seung Il Han, Du Cheol Gang, Byung Gook Lee, Joon Jae Lee
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Inspection Machine

- Part
  - Air Nozzle Conveyor
  - Camera
  - Grouping Box
  - Line Trace

© GV07, 14-17 August 2007, Bangkok, Thailand

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Inspection Object

- Color Grade
- KeyButton Defect Detection
  - Font Defect Detection
  - Scratch Detection

KeyButton & Font Area Detection

- Ortsu Threshold
- Blob Analysis

Affine Transformation

- Reference KeyButton
- Input KeyButton
- Rotation
- Translation

Scratch & Font Defect Detection

- Scratch Detection
- Font Defect Detection
Development of Vision System for Wafer Position Recognition using Radial Shape Calibrator

\[ x_p = \frac{m_0 x_u + m_1 y_u + m_2}{m_6 x_u + m_7 y_u + 1} \]
\[ y_p = \frac{m_3 x_u + m_4 y_u + m_5}{m_6 x_u + m_7 y_u + 1} \]

Digital Area Scan Camera

Radial Shape Calibrator

Binary Image

Calibration

Numbering
Interactive Arts with Image Sensor
- Students Projects

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Hand Tracking

Shadow Garden
2009 세상을 담는 아름다운 그곳 한글

한글 영상 작가진 : [자모향유] 이병국 & 박상현
경복궁 홍래문 앞 한글 박물관 전시관
Interactive Board – IR Pen & Laser Pointer

http://www.youtube.com/watch?v=-tuS3GbHtV8
u-Pointer

a Virtual Interactive Board.

Main Feature of U-Pointer

**Easy Installation**
- Place the U-Pointer on top of the projector and connect it to the PC via a USB cable.
- Align the U-Pointer on the beamed screen and adjust it by knob.
- Light weight along with easy installation enables the U-Pointer to be your presentation partner.

**Interaction with PC via the projected screen**
- Click, double click and drag functions of conventional mouse are all fully supported by the U-Pointer’s pen.
- It can control PC from the projected screen interactively.
- It provides the freedom of a wireless presentation in a seminar or conference, and the size of the projected screen is up to 150 inches.

**Accurate Pen Work**
- The high resolution of the U-Pointer provides the capability of writing smaller characters, than those written with a tablet.
- The fast response time and over 59 frames per second of sampling rate give you the same feeling as if you were using a white board.
**ARToolkit**

Step 1: Getting distortion parameters: ‘calib_dist’

- Selecting dots with mouse
- Getting distortion parameters by automatic line-fitting

Step 2: Getting perspective projection matrix: ‘calib_cparam’

- Manual line-fitting

Input video

Thresholded video

Virtual overlay
A Study on Effective Visual Communication Method with the ‘PICTOMATION’ Contents in Augmented Reality Environment

2007 JUL. DEPT. OF VISUAL CONTENTS, DONSEO UNIVERSITY
Hyoung Myung, Byungseok Lee, Hyungwoo Kim, Shingyuan Kang
http://kowon.dongseo.ac.kr/~lbj/

Definition of pictogram

- The pictogram is a compound word where means the picture and a telegram.
- The pictogram delivers information easily & quickly.

pictogram = picture + telegram

Functions of pictogram

Guidance Function
Public people understand some information easily.

Command Function
The human being must observe.

Pictomation using ARToolkit

Proposal of the pictomation

Visual elements of pictogram should be expressed and reconstituted in common experience, not creation a new one.

“ANIMAL IS DRINKING WATER”
Visual elements : “Man”, “Water” [noun]

“ANIMAL IS DRINKING WATER”
Animation elements : “Drinking” [verb]

First, I abstracted “man” and “water” from linguistic elements in “a man is drinking water” and expressed it as visual elements. Second, I made an animation with behavior elements which is “drink”.

Augmented Reality

AR(augmented reality) provide vivid 3d information
[http://www.mini.de/webcam/]

Embodiment of Augmented Reality Environment

Effective Visual Communication Method

Proposal of the pictumation

Pictumation = Pictogram + Animation

Effective Visual Communication Method

Marker pattern input
Video output (computer graphics area)
Video output (real world area)
Shall we dance?

https://www.youtube.com/watch?v=sMjqvxjB_Yc
Magic Projector

Augmented Reality Projection Tracking
「マジック・プロジェクション」

This technology enables me to automatically

The setup is small and portable. Here is what you need:

T.O.P
Top Of Professional

http://www.marcotempest.com/
http://www.youtube.com/watch?v=i7woG0pqFs
Multi-User Interaction Technology for Ubiquitous Smart Space – Multi Touch System

Dept. of Visual Contents, Dongseo University
Hosung Myung, Namseok Choi, Taehwan Lim, Byunggook Lee
http://kowon.dongseo.ac.kr/~lbg/

This research was financially supporting by the Ministry of Education, Science Technology (MEST) and Korea Industrial Technology Foundation (KOTEF) through the Human Resource Training Project for Regional Innovation.
Mixed Reality Interfaces

Image Deformation

- As one field of computer graphics
- The deformation method of changing image to be wanted by user
  - Used in the filed of computer animation, morphing and medical image
- To perform deformation the user selects some set of handle
  - Points, lines, or grids

Previous Deformation Techniques

- Mesh base method

- Approximation method

Image deformation using RBF

- Since constructing a deformed image from an original one is a mapping from $\mathbb{R}^n$ to $\mathbb{R}^n$. When we have given two sets of 2-dimensional data $U = \{u_1, u_2, \cdots, u_n\}$ and deformed position $V = \{v_1, v_2, \cdots, v_n\}$, we solve for the radial basis function interpolation $S_{fU}(u)$, satisfying

$$S_{fU}(u_i) = v_i - u_i, \quad i = 1, 2, \cdots, n.$$ 

where $v_i - u_i$ is difference vector $v_i$.

- Finally, we obtain a deformed position

$$v = u + S_{fU}(u)$$

Radial Basis Function

- A function $f: \mathbb{R}^n \rightarrow \mathbb{R}^n$ is known only at a set of discrete points $U = \{u_1, u_2, \cdots, u_n\}$ and the deformed function $v$ is given by

$$v(x) = \sum_{i=1}^{n} \phi(||x-u_i||) u_i$$

with $\phi$ radial basis function.

Here, $\phi$ can be approximated using $\phi(||x-u_i||) = \phi(r)$, $r = \|x-u_i\|$.
Digital Contents Fair

2005.12.1~4 서울 코엑스 1층
소프트엑스포 & 디지털콘텐츠페어 2005
소프트웨어체험관 DSU-U Frame,
Laser Pointer Interaction 등 7작품 전시
Digital Contents Fair @ KOEX 2005
IT도 PIFF 바람

동서대, 게스트관리시스템 개발

‘우리 손으로 유비쿼터스 부산국제영화제를 만든다.’

동서대 IT 팀 연구원들이 제 11회 부산국제영화제(PIFF)의 코디네이션을 책임지고 있는 물론

아시안필름마켓의 유비쿼터스 게스트관리

관리시스템을 개발해 화제가 되고 있다.

아시안필름마켓은 40여개국 30여명의 영화산업

종사자들이 참여해 파이낸스에서부터 프로덕션

, 세일즈를 아우르는 행사로 18일부터 23일까지 5

일 동안 부산 해운대 그랜드호텔과 프리미어시네

마에서 열린다.

이 교수와 13명의 대학원생들은 지난 여름방학

동안 교내 유비쿼터스 출고시스템 소스를 아시안

필름마켓에 맞게 수정 및 개선해 게스트 등록에서

부터 인증 등이 자연스럽게 이루어질 수 있는 시스

템을 개발해 프리미어시네마 8층 10개의 상영관 입

구에 설치했다.

이 교수는 “인식거리 2~3m인 90MHz의 무선전자

태그와 리더기를 설치했기 때문에 ID카드 감지가

이 자유롭게 영화관에 입장하면 등록 및 인증이 됨

뿐 아니라 누가 어느 영화를 몇 시간 동안 관람했는

지도 실시간으로 알 수 있어 IT도시 부산의 면모를 보여줄 수 있을 것”이라고 자랑했다.
DJ Mix with Kinect

https://www.youtube.com/watch?v=GXdPaQPfHH0

Han JiaQi

DSU Dongseo University
Deform 2D Shape Manipulation

DEFORM 2D SHAPE MANIPULATION USING DEPTH SENSOR

TYPE: APPLICATIONS

Upload Date: 12 Mar 2013 10:05:43 AM
Last Update: 20 Mar 2013 11:40:53 AM
Developer: Yeouf Tan
Category: Body Tracking
Version: 1.0

IAI (Institute of Ambient Intelligence) introduce OpenNI compliant 3D sensor + 2D Shape Manipulation which allow you to controlling 2D Shape (Image, Animation) by using controlling through sensor kits (every OpenNI compliant 3D sensor)

With the combination of Deform 2D Shape Manipulation + 3D Sensor, user able to move freely in animation or cartoon image by using body movement such as hand, legs and arm.

http://www.openni.org/files/deform2d-shape-manipulation/#.UT8Bhxpkky4
https://www.youtube.com/watch?v=HKt8Qt4bLvI
Multi Touch System with Kinect

[url: http://www.youtube.com/watch?v=leXT2r1bYBY]

1-inch UniTouch System using Kinect

Dept. of Visual Contents, Dongseo University
Seok-min Hong, Yung-fu Tan, Hui shyong Yeo,
Byung-gook Lee

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http://kowan.dongseo.ac.kr/~lbg/

This research was supported by Basic Science Research Program through the National Research Foundation of Korea(NRF) funded by the Ministry of Education, Science and Technology
http://www.youtube.com/watch?v=9NT1RGGfplw

Virtuallog cube5.0

Dept. of Visual Contents, Dongseo University
Huang hliangdan
Prof. Byungguck Lee, Byoungjin Ahn

DSU Dongseo University
IAI

Play in the theme park

Let's dancing on the stage
MultiLevel AR

https://www.youtube.com/watch?v=-KrscAONVwl

Multi-Level Visualization AR Application
MiniCar with Arduino

http://www.arduino.cc/
https://www.youtube.com/watch?v=WFNtsA8P8D8
MagicalSketchPad

https://www.youtube.com/watch?v=y3w33wE_OrM
LookEdu@AR

https://www.youtube.com/watch?v=2Byzr1nQ-aE
제3차 “슈퍼앱 코리아” 대회

동서대 학생들 앱 개발 경진대회 ‘천하 황령’

동서대학교 학생들이 학문적 인생과 관련된 다양한 분야에서 주제를 다루고 있으며, 학생들이 독립적으로 개발한 앱은 전통적인 학문적 토론보다는 실생활에 더 가까운 주제로 구성되어 있다. 특히, 앱의 내용은 대학 생활, 학업, 취업 등과 관련된 문제를 다루며, 다양한 분야의 학생들이 참여하고 있다. 이번 대회는 앱을 통해 학생들의 창의성과 실용성을 보여주고 있으며, 향후 앱 개발을 위한 기회를 제공하기도 한다.

3개 팀 출전 최우수-우수-장려상 획득

외국 유학생들과 함께 성공과 거두는 ‘화제’

동서대학교는 다양한 외국 유학생들이 학교에 입학하여 교육과 생활을 하게 되면서, 다양한 문화와 소통을 통해 새로운 경험이 주어진다. 특히, 외국 유학생들은 한국의 문화와 언어, 사회를 배우는 것에 흥미를 가지고 있으며, 그들과의 소통은 학생들의 성장에 큰 도움이 된다. 이번 대회에서는 외국 유학생들과 함께한 팀이 3개 팀 중 최우수, 우수, 장려상으로 선정되어 큰 성과를 기록하였다.
Thanks you!!

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http://kowon.dongseo.ac.kr/~lbg/
Development of high-definition 3D image processing technologies using advanced integral imaging with improved depth range

Real 3D Display System

3D Contents Generation

Time/Space multiplexing

Real 3D image

Viewers

Lens Array Design

Advanced Integral Imaging System

Development of high-definition 3D image processing technologies using advanced integral imaging with improved depth range

2012 지식경제부 및 한국산업기술평가관리원 KEIT의 산업융합원천기술개발사업(정보통신), 미래창조과학부 및 정보통신기술진흥센터 IITP의 정보통신미디어산업원천기술개발사업 - 집적영상(IP) 깊이 표현 범위를 개선한 고선명 3D 영상 처리 기술

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3/1/2016
Lens Array

First lens array

Display Device: Barco3420
Resolution: 2048 x 1536
Pixel Size: 0.207 mm
Dimension: 684 mm x 385.3440 mm
Number of Lens Array: 426x240
Focal Length: 8.028 mm
Radius: 1.6056 mm

Second lens array

Display Device: IBM t221
Resolution: 3840 x 2400
Pixel Size: 0.1245 mm
Dimension: 679.77 x 380.97 mm
Number of Lens Array: 91x51
Focal Length: 29.88 mm
Radius: 7.47 mm
DPII 3D Display System

- Time Multiplexing Display Device Panel BenQ XL-2411T 24” 1920x1080 pixel pitch 0.276 mm
- Lens array 330x186 24” focal length 8.028 mm radius 1.6056 mm
- DPII System : Viewing Angle 1.974 Depth Range 50 cm
RPII 3D Display System

- IBM T221 22" 3840x2400 Pixel Pitch 0.1245 mm
- Lens Array 69x39 22" Focal Length 29.88 mm Radius 7.47 mm
DPII 3D Display System

- Display Panel: Dell UP2414Q 24” 3840x2160 Pixel Pitch 0.137mm
- Lens Array 330x186 24” Focal Length 8.028 mm Radius 1.6056mm
Eye Tracking with Kinect Calibration

This work was supported by the IT R&D program of MKE/KEIT. [10041682, Development of high-definition 3D image processing technologies using advanced integral imaging with improved depth range]

본 연구는 지식경제부 및 한국산업기술평가관리원의 산업융합원천기술 개발사업(정보통신)의 일환으로 수행하였음. [10041682, 임상영상(IP) 길이 표현 범위를 개선한 고성능 3D 영상 처리 기술]
산업융합원천기술(산업융합기술)에 대한 집중 지원을 통해 미래 신산업을 육성하고 세계 최고 수준의 정보통신 원천기술을 확보하여 미래 신성장 동력을 창출하는 필요가 있어, 그 중 한 가지로는 정보통신 및 신산업 분야의 원천기술 및 엔지니어링기술에 대한 집중 지원이 필요하다.

II. 신규과제 집수 현황 및 분석

집수 현황

- 유효집수 과제수 : 144개(공과계계 66개)
- 과제유형별 집수량
  - 일반형 과제는 2:3, 통합형 과제는 1:1, 명백형 과제는 5:1

<table>
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집수 현황 분석

- 학계/연구계 종합과제건수는 '11년 대비 변동이 없으나, 산업체의 지원과제 수는 '11년 49개에서 96개로 51% 증가하였음
- 이는 정보통신 및 신산업 분야의 R&D 여건이 개선되어 기업의 혁신활동을 촉진한 것으로 보인다.
- 2012년 신청주관기관별로는 산업부 78개, 인터넷 43개, 국립산학연협력 22개, 해양수산부 17개 등으로 분포되어 있다.

III. 신규과제 평가 현황 및 분석

- 사업시행기간
  - 총 66개 과제 중 66개 과제 중 61개 과제, 70개 사업자가 선정
  - 5개 과제 미선정 : 산업기술(60)미적용 5개

- 성과평가
  - 2012년 1월 신청주관기관별로는 산업부 78개, 인터넷 43개, 국립산학연협력 22개, 해양수산부 17개 등으로 분포되어 있다.
### CGIV Members

**Professor**
byung-sook lee, joon-jae lee, hwang-kyu yang, suk-ho lee, tae-gyoun gyou

**Ph.D. Students** : nam-seok choi

**M.S. Students** : jeong-seok moon, ki-young sung, sung-jin kim, rishu gupta, gi-bong kim, jongsuk son, jongsil yoon, wang feiyan, liu peng xin, wang ping, han cheng si

**B.S. Students** : jae hyuk yeon, myung-soo kim, ho-hwan shin, nam-yong jeon, min-sun park, ji-young moon, kyung-min lee, tae-ryang hwang, joon-hyung hong, kwan-ho kim, mingi kum

**Internship Students ▼(More...)**

**Alumni ▼(More...)**

### NOTICE Board

<table>
<thead>
<tr>
<th>Schedule, Conference 2008, 2009</th>
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<tr>
<td>▶ CGIV Seminar Nov 11 T... 2010.11.09</td>
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### CGIV Projects

- The Second BK21 : Advanced Technology for Visual Contents Production (06.03~13.02)
- NRF10 : Digital Image Processing and Synthesis for Clear Vision (10.05~13.04)
- SMBA10 : 2D영상의 3D 입력 영상 변환에 적합화된 멀티 레이어 생성 및 보정 솔루션 개발 with AZWorks (10.06~12.05)
- IAI : Institute of Ambient Intelligence - Aml assisted Maritime Ecomonitoring System (08.04~11.03)
- NRF09 : Korea-EU Co-operation Research Project Planning for Aml assisted Maritime Eco-Monitoring System (09.12~10.11) ▼(More...)

### RESEARCH Fields

- Eco Monitoring : jeong-gyu hwang, jeong-seok moonsun-hye cho
- Super Resolution : dong-jin kim
- Background Modeling : nam-seok choi, tingting li
- Motion Estimation : tae-kyung ryu
- 3D Hand Tracking : nam-seok choi
- USB Camera Hand Tracking : sung-il han
- Automatic Photo Pop-up : ki-young sung
- Wafer Calibration : jung-woo lee
- Multi Touch Screen : nam-seok choi
- ARToolkit : dong-jin kim, eun-kyung jung
- DIT Conversions : hyo-sung myung
- Processing : ki-young sung
- PTZ Camera Control : ki-young sung
- ActionScript 3.0 : jeong-seok moon, sung-jin kim
- Polygonal Simplification : nam-woo kim
- FPD Mura Detection : 
- Etc : nam-seok choi
- 3D Deformation : nam-seok choi, tingting li
- Integral Image : dong-hak shin,
- CGIV | lbg@dongseo.ac.kr | 3/1/2016
Korea Mathematical Methods for Curves and Surfaces
Dongseo 2006

August 28-29, 2006, Ewha Univ., Seoul, Korea with financial support from Ewha Univ.

Korea Mathematical Methods for Curves and Surfaces
Dongseo 2005

June 23-25, 2005, Dongseo Univ. Graduate School of Software, Design Hall, Korea
with support from Dongseo Univ.

Korea Mathematical Methods for Curves and Surfaces
Dongseo 2004

August 9-13, 2004, Dongseo Univ. Graduate School of Software, Design Hall, Korea

3/1/2016
lbglbg@dongseo.ac.kr
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