Surgical Data Science
hutom role & responsibility

2019. 09. 27

hutom

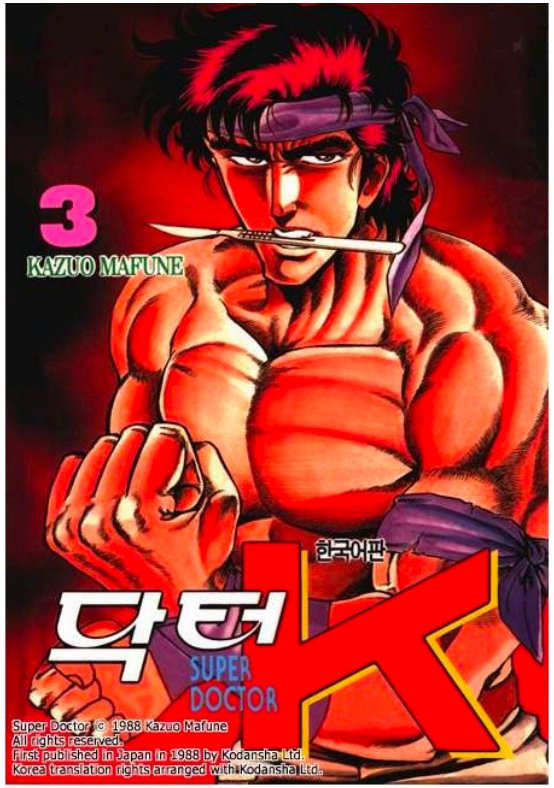
surgical data science

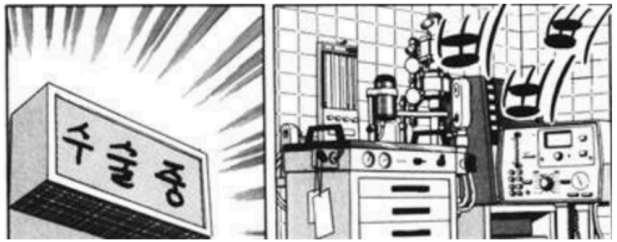
hutom

수술 중 발생하는 **문제**를
데이터를 기반으로 해결

Problem **DATA**

Data in Surgery

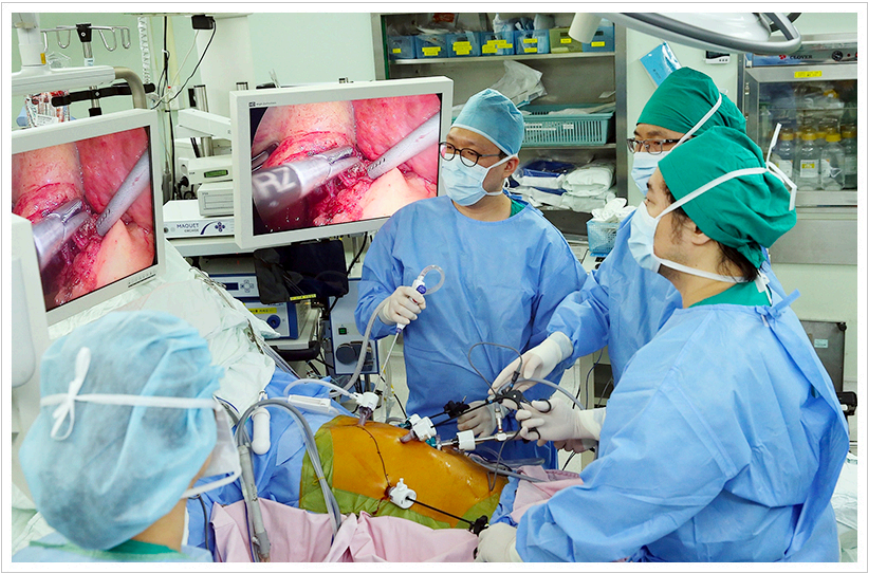




Minimally Invasive Surgery

Medical specialty that uses operative manual and instrumental techniques on a patient to treat a pathological condition to help improve bodily function

https://www.wikipedia.org/wiki/robotic_surgery

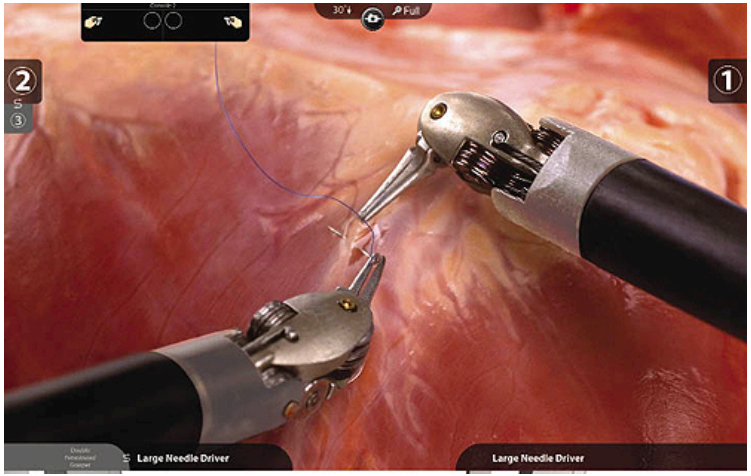


http://www.amc.seoul.kr/asan/information/journal/journalDetail.do?journalId=12165


KAPWING

SEE: Stereo Camera (visual feature)

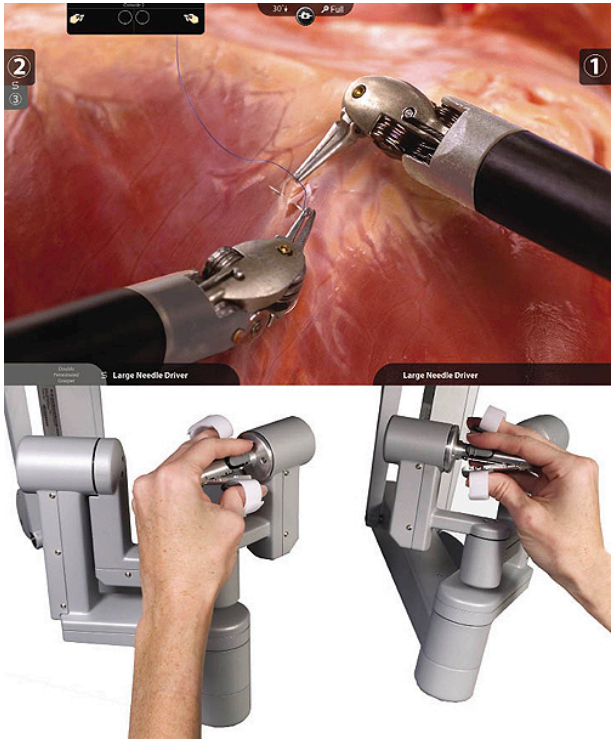
a pair of cameras interfaced to a field sequential stereoscopic display viewed with stereo glasses to achieve the desired 3D visual effect



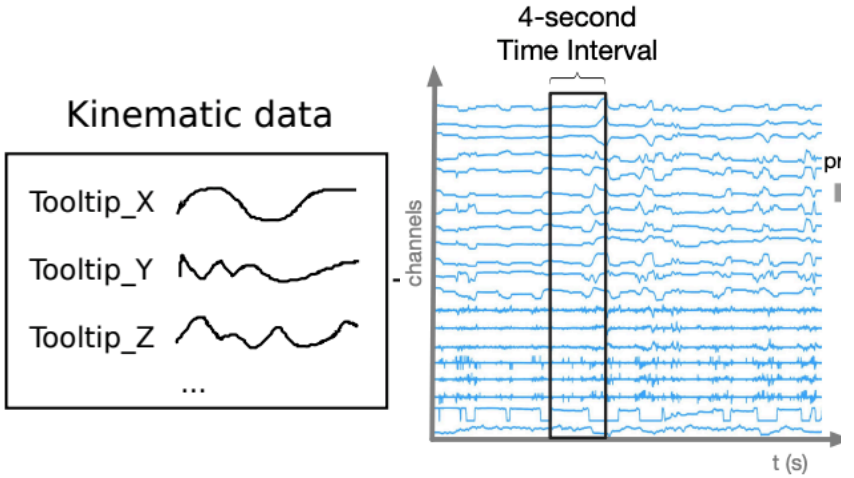
https://www.designworldonline.com/entering-age-surgical-robotics/

https://www.intuitivesurgical.com/test-drive/pages/crystal-clear-3dhd.php
https://www.slideshare.net/AdityaKejriwal2/anesthesia-for-robotic-surgery

DO: Robot Arm Controller (kinematics)

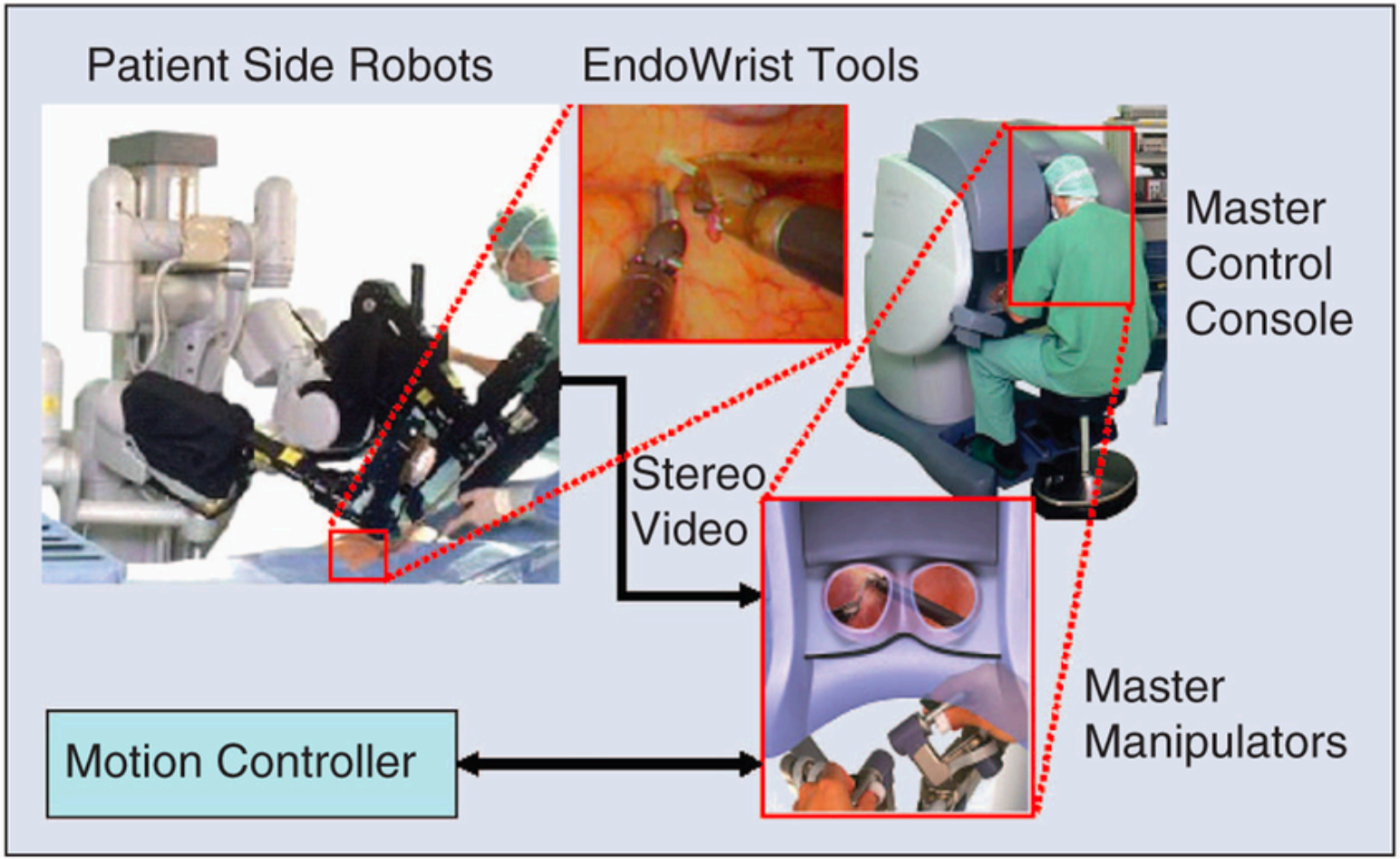


DVLogger



https://www.designworldonline.com/entering-age-surgical-robotics/

Hung et al., Development and Validation of Objective Performance Metrics for Robot-Assisted Radical Prostatectomy, The Journal of Urology 2018, 199, 263-304

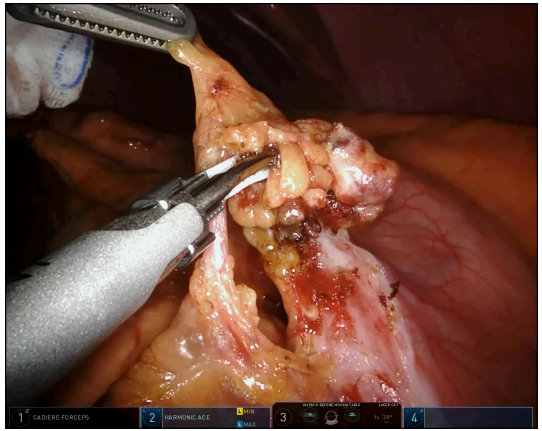


P Kazanzides et al. *Surgical and interventional robotics – core concepts, technology, and design (2008)*

Surgical Data

Dataset used for monitoring, analysis, and recognition of the surgery to provide context-aware assistance by various support system including mechatronic platforms such as surgical robots

Sensor Information



Surgical Video

	PatientNo	SurgicalNo	Survival.months	Death	No.of.LN.meta
1	23657029	00-S -003670	34	1	0
2	23723731	00-S -004019	19	1	0
3	24149831	00-S -018982	60	1	0
4	14796850	00-S -020473	10	1	0
5	11751795	00-S -020535	20	1	0
6	24117687	00-S -021809	17	1	0
7	16475856	00-S -029565	140	0	0
8	25014767	01-S -001512	10	1	0
9	25160824	01-S -005484	1	1	0
10	25247062	01-S -006861	32	1	0
11	25275454	01-S -007899	137	0	0
12	15587617	01-S -013431	71	1	0
13	25550232	01-S- 018519	14	1	0

Electric Medical Record

D A Hashimoto et al. (2018). Surgical video in the age of big data. *Annals of Surgery*
F Lalys and P Jannin (2014). Surgical process modelling: a review. *IJCRS*
R Stauder et al. (2017). Surgical data processing for smart intraoperative assistance systems. *Innov Surg Sci*

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Problem in Surgery: Bleeding

SURGICAL BLEEDING

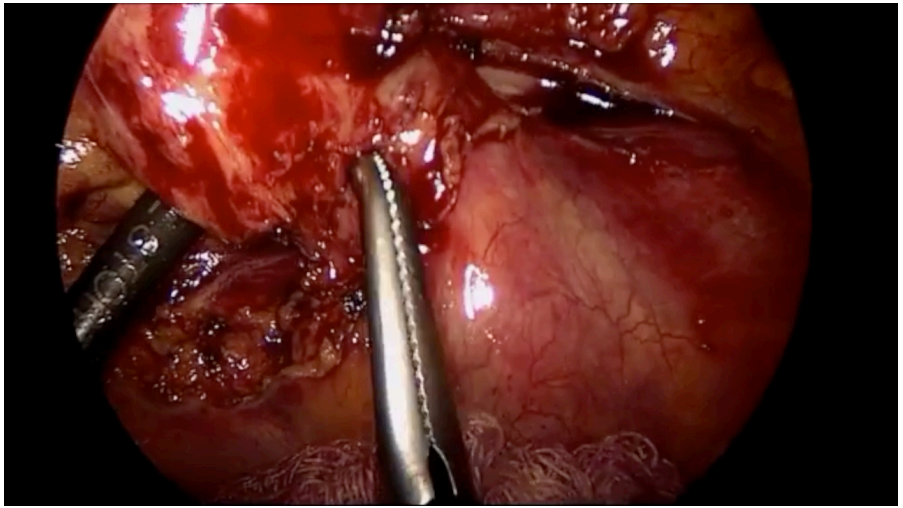
EVERY YEAR, AN ESTIMATED 230 MILLION PEOPLE UNDERGO MAJOR SURGICAL PROCEDURES WORLDWIDE.BLEEDING IS AN IMPORTANT COMPLICATION AND MANY PATIENTS REQUIRE A BLOOD TRANSFUSION.

ABOUT ONE THIRD OF TRANSFUSED BLOOD IN THE UK IS USED FOR SURGICAL PATIENTS WHO RECEIVE AN AVERAGE OF TWO UNITS. HOWEVER, BLOOD FOR TRANSFUSION IS A SCARCE AND COSTLY RESOURCE AND MOST PEOPLE IN THE WORLD DO NOT HAVE ACCESS TO DONOR BLOOD. FURTHERMORE, BLOOD TRANSFUSION IS NOT WITHOUT RISK.

TXA HAS BEEN USED FOR MANY YEARS IN SURGERY AND THERE IS GOOD EVIDENCE FROM RANDOMISED CONTROLLED TRIALS THAT IT REDUCES SURGICAL BLEEDING. A SYSTEMATIC REVIEW IDENTIFIED 130 TRIALS INCLUDING 10,528 PATIENTS. THE RESULTS SHOWED THAT TXA REDUCES THE PROBABILITY OF RECEIVING A BLOOD TRANSFUSION BY 40% (RR=0.60, 95% CI 0.56 TO 0.64; P<0.001). THIS EFFECT WAS SEEN ACROSS DIFFERENT SURGICAL PROCEDURES AND REMAINED LARGE WHEN THE ANALYSIS WAS RESTRICTED TO THE 29 TRIALS WITH GOOD ALLOCATION CONCEALMENT (RR=0.66, 95% CI 0.60 TO 0.73; P<0.001).

A TOTAL DOSE OF 1 G APPEARS TO BE SUFFICIENT FOR MOST ADULT SURGICAL PATIENTS. HOWEVER, THE EFFECTS OF TXA ON THROMBOEMBOLIC EVENTS AND MORTALITY IN SURGERY ARE UNCERTAIN. ALTHOUGH THERE WERE FEWER DEATHS AND MYOCARDIAL INFARCTIONS IN THE TXA GROUP, THE POOLED ESTIMATES WERE IMPRECISE, AND BECAUSE MANY TRIALS DID NOT REPORT DATA FOR THESE OUTCOMES, THERE IS THE POTENTIAL FOR BIAS DUE TO SELECTIVE REPORTING. THE UNCERTAINTY CONCERNING THE EFFECT ON THROMBOEMBOLIC EVENTS IS AN IMPORTANT FACTOR LIMITING THE UPTAKE OF TXA SINCE AN INCREASE IN THROMBOSIS COULD OUTWEIGH THE BENEFITS OF REDUCED BLOOD USE.

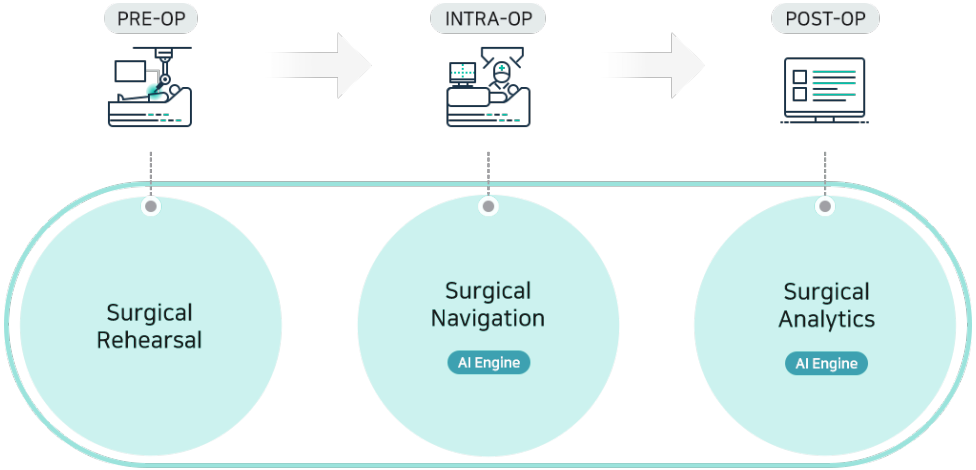
http://www.txacentral.org/bleeding-conditions/surgical-bleeding



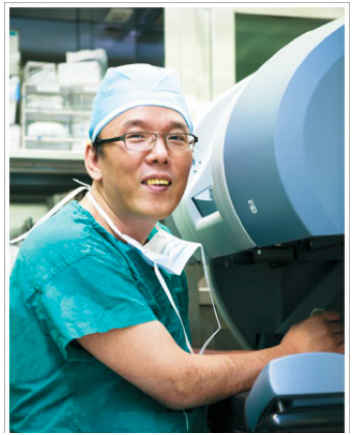
https://www.youtube.com/watch?v=eFEGgepMe6w

FAIR ENVIRONMENT

hutom product



You can't HSP be the smartest at this moment,
As it is growing smart much faster than ever.



CEO
형우진, MD, PhD

- 현) 연세대학교 의과대학 외과학교실 교수
- 연세대학교 의대 학사, 석사
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Chief AI Scientist
김준모, PhD

- 현) KAIST - 전기 및 전자공학부 부교수
- 삼성종기원 Staff (2005 ~ 2009)
- MIT EECS, MS (2000), Ph. D.(2005)
- SNU, BS (1998)

CTO
어수행, PhD

- KT AI Tech Center
- Encored Technologies, INC
- Dental Research Institute, SNUH
- PhD in Statistics, Korea Univ.

최민국 Research Scientist
허성환 SW Engineer
양훈모 SW Engineer
장근호 SW Engineer
이지원 DATA Researcher

송치현 Research Engineer
하헌진 Research Engineer
김하진 UI/UX Planner
유하영 3D Modeler
홍슬기 Research Residency
임자연 Research Intern
이송아 SW Intern

hutom Clinical Advisors

세브란스 SEVERANCE

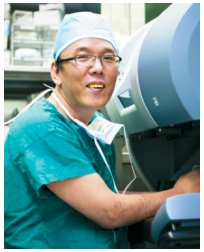
고려대학교의료원 KOREA UNIVERSITY MEDICAL CENTER

가톨릭대학교 은평성모병원 THE CATHOLIC UNIV. OF KOREA EUNPYEONG ST. MARY'S HOSPITAL

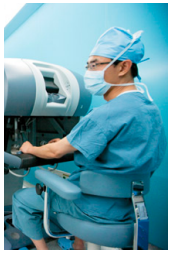
가톨릭대학교 서울성모병원 THE CATHOLIC UNIV. OF KOREA SEOUL ST. MARY'S HOSPITAL

경희의료원

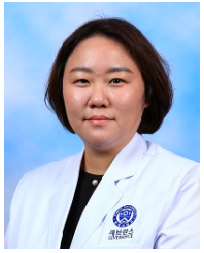
위장관



형우진 교수



한상욱 교수



김유민 교수

송교영 교수

대장항문

김선한 교수

이길연 교수

갑상선

정웅윤 교수

이소희 교수

영상의학

임준석 교수

HUMAN TOUCH IN MEDICINE

Research Product Output

hutom

메이저 학회 1편, SCI저널 2편 (+3), 특허 등록 29편, 출원 27편

Proceedings of Machine Learning Research – XXXX:1–11, 2019 Full Paper – MIDL 2019

DavinciGAN: Unpaired Surgical Instrument Translation for Data Augmentation

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Min-Kook Choi MKCHOI@HUTOM.CO.KR
Heechul Jung HEECHUL@HUTOM.CO.KR

Abstract

Recognizing surgical instruments in surgery videos is an essential process to describe surgeries, which can be used for surgery navigation and evaluation systems. In this paper, we argue that an imbalance problem is crucial when we train deep neural networks for recognizing surgical instruments using the training data collected from surgery videos since surgical instruments are not uniformly shown in a video. To address the problem, we use a generative adversarial network (GAN)-based approach to supplement insufficient training data. Using this approach, we could make training data have the balanced number of images for each class. However, conventional GANs such as CycleGAN and DiscoGAN, have a potential problem to be degraded in generating surgery images, and they are not effective to increase the accuracy of the surgical instrument recognition under our experimental settings. For this reason, we propose a novel GAN framework referred to as DavinciGAN, and we demonstrate that our method outperforms conventional GANs on the surgical instrument recognition task with generated training samples to complement the unbalanced distribution of human-labeled data.

Keywords: Generative adversarial network (GAN), image-to-image translation, self attention, data augmentation.

Fast and Accurate Convolutional Object Detectors for Real-time Embedded Platforms

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Abstract

With the improvements in the object detection networks, several variations of object detection networks have been achieved impressive performance. However, the performance evaluation of most models has focused on detection accuracy, and the performance verification is mostly based on high-end GPU hardwares. In this paper, we propose real-time object detectors that guarantees balanced performance for real-time system on embedded platforms. The proposed model utilizes the basic head structure of the RefineDet model, which is a variant of the single shot object detector (SSD). In order to ensure real-time performance, CNN models with relatively shallow layers or fewer parameters have been used as the backbone structure. In addi-

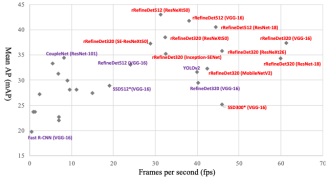


Figure 1. Speed (fps) versus accuracy (mAP) on MS-COCO *test-dev*14 or 17. Out models (red color) have a balanced speed and accuracy compared to the existing real-time-oriented models (purple color). Performance of the proposed models were measured on the NVIDIA Titan XP. Details of the performance measurements are described in Section 4.

Original Article

A sparse principal component analysis of Class III malocclusions

Tae-Joo Kang[a]; Soo-Heang Eo[b]; HyungJun Cho[c]; Richard E. Donatelli[d]; Shin-Jae Lee[e]

ABSTRACT

Objectives: To identify the most characteristic variables out of a large number of anatomic landmark variables on three-dimensional computed tomography (CT) images. A modified principal component analysis (PCA) was used to identify which anatomic structures would demonstrate the major variabilities that would most characterize the patient.

Materials and Methods: Data were collected from 217 patients with severe skeletal Class III malocclusions who had undergone orthognathic surgery. The input variables were composed of a total of 740 variables consisting of three-dimensional Cartesian coordinates and their Euclidean distances of 104 soft tissue and 81 hard tissue landmarks identified on the CT images. A statistical method, a modified PCA based on the penalized matrix decomposition, was performed to extract the principal components.

Results: The first 10 (8 soft tissue, 2 hard tissue) principal components from the 740 input variables explained 63% of the total variance. The most conspicuous principal components indicated that groups of soft tissue variables on the nose, lips, and eyes explained more variability than skeletal variables did. In other words, these soft tissue components were most representative of the differences among the Class III patients.

Conclusions: On three-dimensional images, soft tissues had more variability than the skeletal anatomic structures. In the assessment of three-dimensional facial variability, a limited number of anatomic landmarks being used today did not seem sufficient. Nevertheless, this modified PCA may be used to analyze orthodontic three-dimensional images in the future, but it may not fully express the variability of the patients. (*Angle Orthod.* 2019;89:768–774.)

KEY WORDS: Principal component analysis; three-dimensional image

RODUCTION

/hen a data set has a large number of variables, cipal component analysis (PCA) is a popular method of summarizing the information.[1–8] PCA compresses original variables into several sets of linear combinations of variables. In theory, the reduced set of variables, known as the principal components (also

HUMAN TOUCH IN MEDICINE

hutom Culture

hutom Culture: (개발)환경

Planet 스케일 개발을 위한 최고수준 개발 환경

Google Cloud

Confluence

Jira

GitHub

G Suite

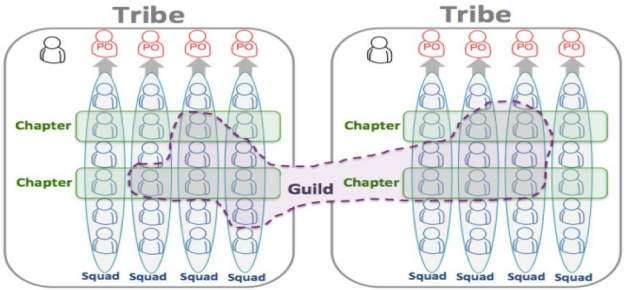
hutom Culture: 사람

좋은 스타트업

=

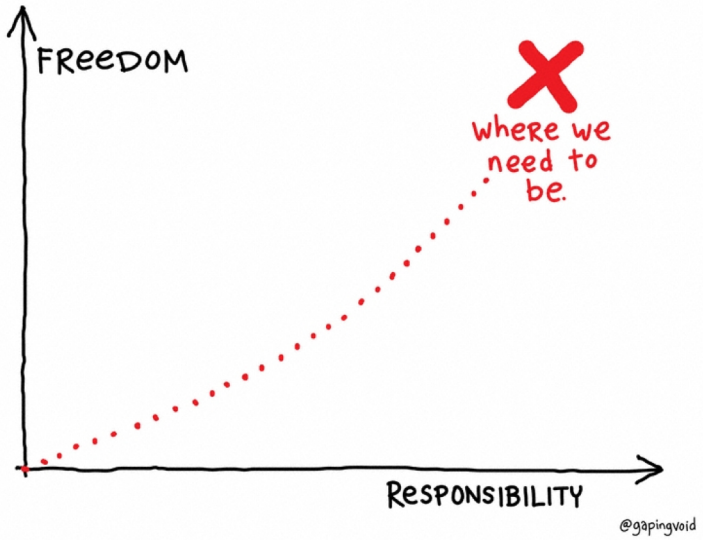
구성원의 성장 지원 조직문화

Spotify®



https://labs.spotify.com/2014/03/27/spotify-engineering-culture-part-1/

연구 중심의 개발문화 (실패는 성공의 어머니)



- 구성원 본인이 하고 싶은 일을 하는 것
  (제품과 .00001%라도 연관있으면 OK)
- 실패를 존중하는 분위기
  (다양한 시도 화이팅!)
- BUT, **OUTPUT**을 생산
  (output으로 교훈 가능)

능력있는 인재를 위한 합리적 대우

- **대기업 수준 처우**
- 코어타임 근로제 (10 to 16)
- 눈치보지 않고 사용하는 자유로운 휴가 (휴가 기안은 휴가가 본인)
- **자유롭게** 공부할 수 있는 분위기
- 명절상여금 + 한우세트 (설, 추석)
- 특허/논문보상비
- 자기개발비
- 점심/저녁/간식 **무제한** 제공
- 우리만 사용하는 캡슐~ 커피머신
- 업무유관 도서 원하는 만큼 구입
- 업무유관 세미나 & 컨퍼런스 원하는 만큼 참석 지원 (ICCV2019및 유관 학회 등)

hutom Role Model

승부욕이 강한 사람

Learning-curve가 높은 사람

hutom Role Model

https://nbamania.com/g2/bbs/board.php?bo_table=humor&wr_id=86961

hutom Role Model

승부욕 in hutom = 이길때까지 지치지 않고 살아남는 것

1. 시간차가 있는 사람의 성취는 인정
2. 정말 노력해도 안되면 인정
3. 과거와 스스로 경쟁
4. 부족한 것에 솔직

https://ppss.kr/archives/144047

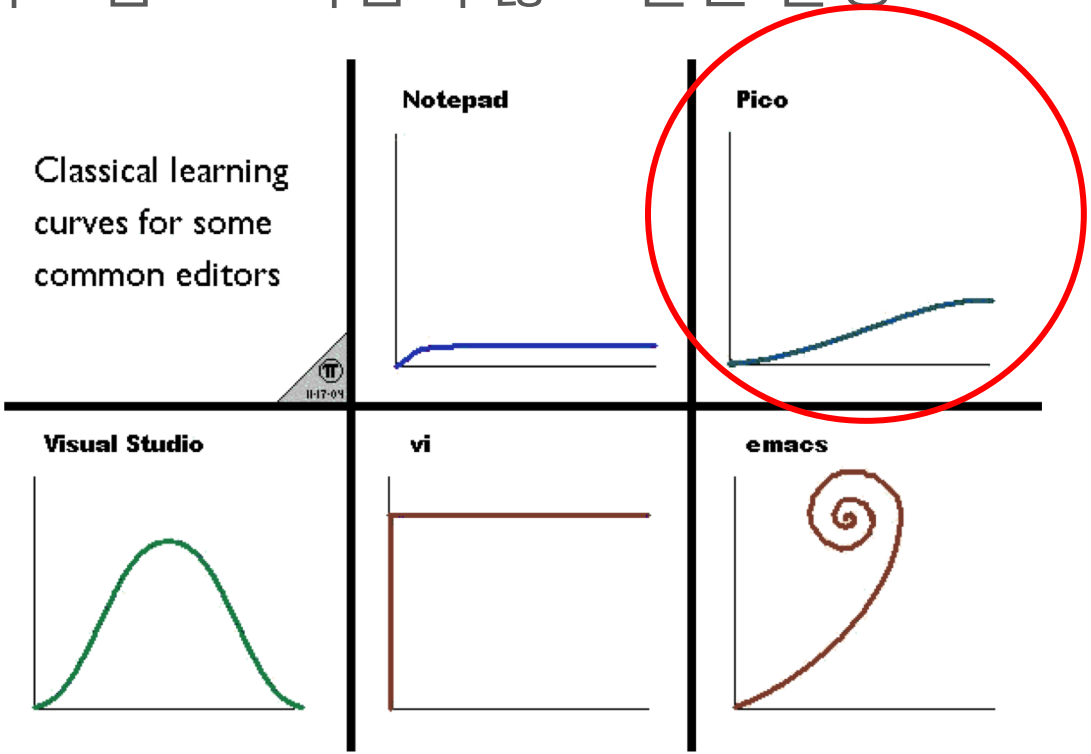
Learning Curve in 스타트업 = 호기심이 많고 일단 실행

Learning-curve가 높은 사람

처음부터 완벽한 사람은 없음

배움, 성장에 대한 의지가 있는 사람
= 새로운 것을 두려워하지 않고, 받아들이는 자세

스스로 문제를 분석할 줄 알며,
빠르게 행동으로 옮기는 사람



Standardize Surgery
by distilling meaning from DATA

hutom