객체 3D 위치/자세 인식 모델 실행 메뉴얼

객체 3D 데이터 (대용량) 유효성 검증

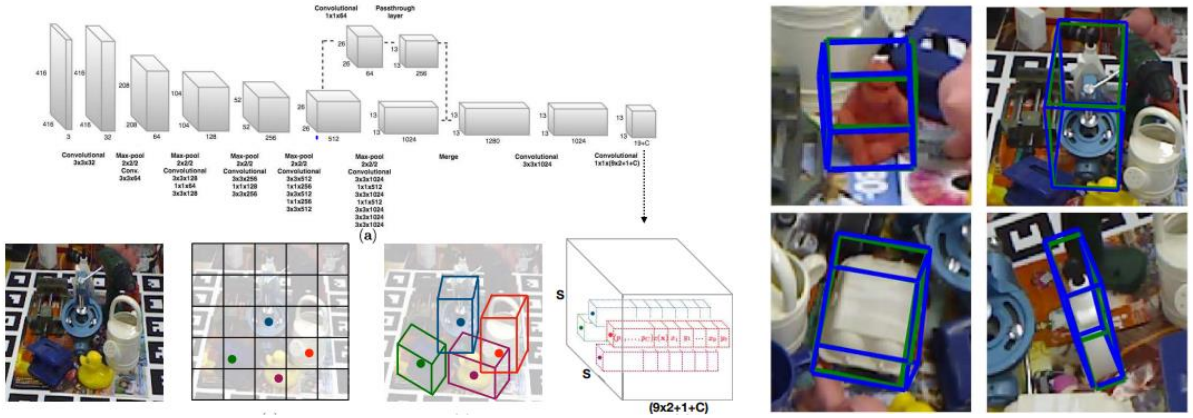
https://github.com/seongheum-ssu/nia-ssp

최초 작성: 2021.12.31

최종 업데이트: 2022.02.15

유효성 검증 개요

- 목적: 1) 3D 위치 추정, 2) 3D 자세 추정 → 공간 상의 6자유도 자세 추정 (6D Pose Estimation).
- Single Shot Pose 모델을 통해 객체의 3D 위치/자세를 추정하고, 성능을 정량적으로 측정함.



▲ 객체 3D 데이터의 레퍼런스 AI 모델 결과 예시

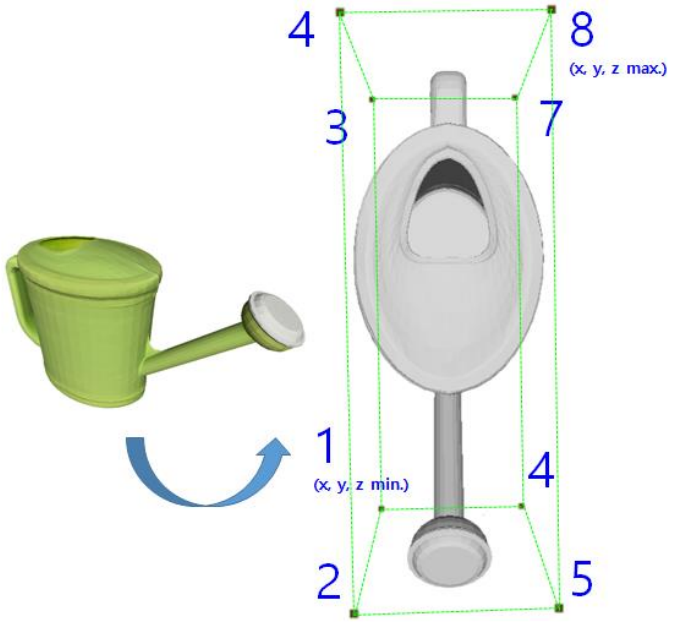
▲ 객체 3D 데이터 학습 결과 및 분석

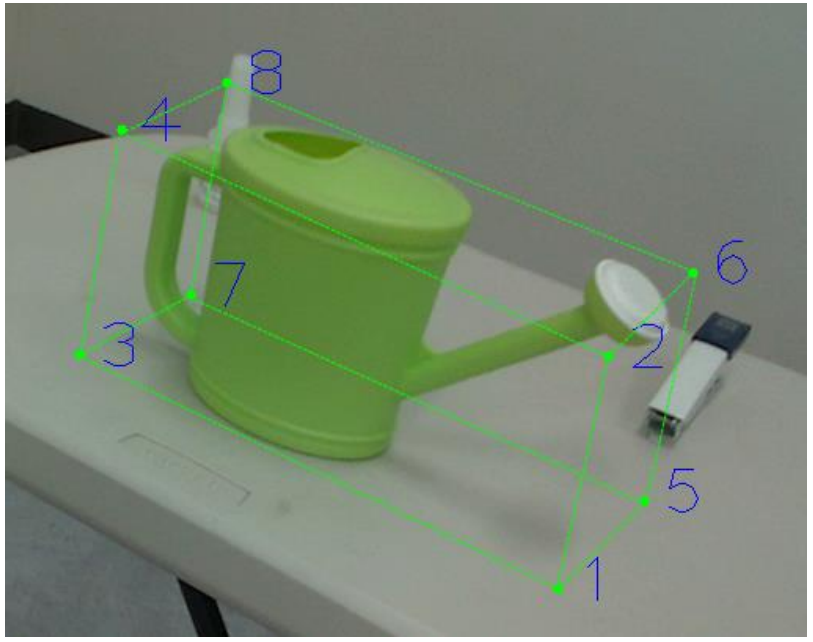
인공지능 학습 모델 개발 (객체 3D 데이터)	
개발 언어	Python 3.6
프레임워크	PyTorch 1.8.0, CUDA 11.1, OpenCV 4.5.3.56, SciPy 1.2.0, Pillow 8.2.2
학습 알고리즘	**Real-Time Seamless Single Shot 6D Object Pose Prediction (CVPR18)** 설치 및 테스트: https://github.com/seongheum-ssu/nia_singleshotpose
입력 정보	학습/평가 데이터: .jpg (영상), .txt (자세), .png (영역), .ply (3D 데이터)
출력 정보	객체 당 큐브의 꼭지점을 예측. 이를 통해 3D 위치/자세 값을 계산.
테스트 방법	공인 LINEMOD 데이터셋: https://paperswithcode.com/dataset/linemod-1

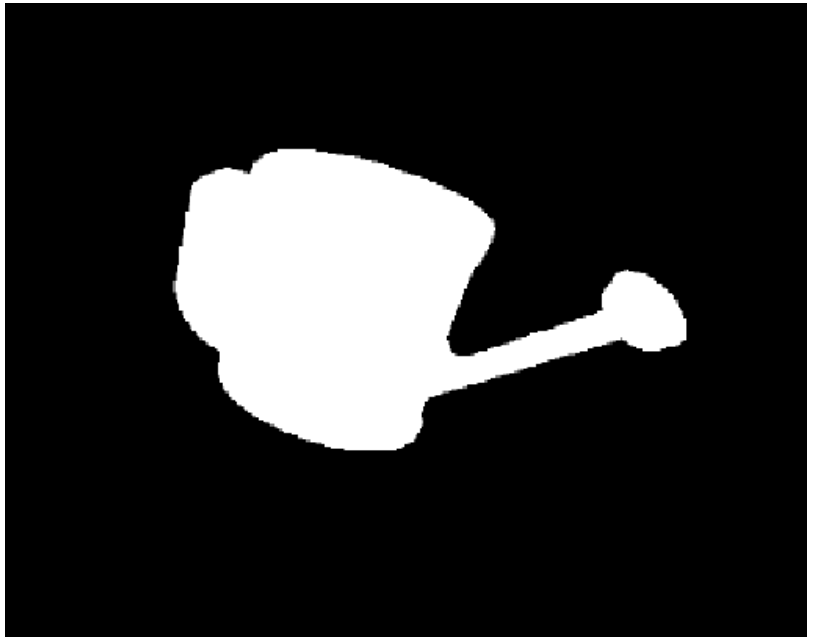
유효성 검증 관련 주요 내용	
학습 조건	레퍼런스 논문에서 LINEMOD 데이터로 진행한 내용, 조건을 그대로 적용.
파일 형식	학습/평가 데이터: .jpg (입력), .txt (자세), .png (영역), .ply (3D 데이터)
모델 학습 데이터 분류 및 비율 정보	Training 비율: 클래스별 인스턴스의 80% Validation/Test 비율: 클래스별 인스턴스의 20% * 총 구축 건 수의 20%인 6만장 이상으로 평가용 데이터셋을 구성함.
목표 성능	대용량: 2D reproj. 기반 평균 82.5% 이상, IoU 기반 평균 87.5% 이상
최종 결과 계산 시 사용된 값	2D reproj. 기반 정확도: 자세추정 reprojection error가 20 pixels 미만인 경우만 참인 것으로 판단. IoU 기반 정확도: 예측한 자세 (R,t)로 3D 모델을 영상으로 투영하여 해당 객체 영역과 overlap이 50% 이상이어야 함.

유효성 검증 개요

- 객체 3D 데이터 소개







1. 3D 모델 (객체의 3D 형상 정의) **2. 3D 큐브 (투영된 위치/자세를 정의)** **3. 투영된 객체 영역 (배경 증강에 활용)**

- 공간 상의 3D 큐브는 포인트 클라우드의 (minx,miny,minz)과 (maxx,maxy,maxz) 두 점으로 정의
- 2D 큐브는 객체 영역의 (minx,miny)와 (maxx,maxy)로 생성 가능. 객체 영역만 유효성 검사 진행함.
- 상용화 된 제품으로 Depth를 측정. 논문에서도 RealSense 출력은 GT로 그대로 인정함. 최종 형태인 3D 모델로 성능을 평가함. 3D 모델의 텍스쳐는 유효성 평가에 고려되지 않음.

도커이미지 사용 방법

- 도커 이미지를 생성하여 평가/분석
  - https://github.com/seongheum-ssu/nia-ssp 의 Readme 참조

- 폴더 구조 설명 (root 이하)
  - docker_images/ → 도커이미지, 소스 파일 관리
  - test_datasets/ → 평가용 데이터셋
  - experimental_results/ → 시험 결과 출력, 성능 분석 및 로그 파일 (.txt, .csv)

- 생성된 도커이미지를 활용하는 방법

Step 1) git clone https://github.com/seongheum-ssu/nia-ssp

Step 2) wget https://www.dropbox.com/s/o16mx914up6oen2/nia-ssp.tar?dl=0 -O docker_images/nia-ssp.tar

Step 3) docker load -i docker_images/nia-ssp.tar

- 평가용 데이터셋 (S3) 및 학습 데이터셋 포함 (압축파일)

Step 1) ./run.sh 070308 (개별 실행, ./test_datasets/에 평가용 데이터셋이 없다면 직접 다운로드하여 진행)

Step 2) ./run.sh all (모든 테스트셋을 차례로 진행. 객체별로 유효성 검증 진행. 1건당 15분 미만 소요)

도커이미지 사용 방법 (참고)

- **S3 Browser를 활용하여 도커 이미지를 다운 받아 로드하는 경우,**

> docker load -i docker_images/nia-ssp.tar

```
seongheum@vip-02: ~/Workspace/NIA-3DObj/nia-ssp-docker
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ docker ps -a
CONTAINER ID   IMAGE     COMMAND   CREATED   STATUS    PORTS     NAMES
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ls docker_images/
nia-ssp.tar
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ docker load -i docker_images/nia-ssp.tar
```

- **Git에서 관리되는 소스코드를 build하여 도커 이미지를 생성하는 경우,**

> git clone https://github.com/seongheum-ssu/nia-ssp

> ./build.sh

```
seongheum@vip-02: ~/Workspace/NIA-3DObj/nia-ssp-docker
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ls docker_images/cfg/
Dockerfile  environment.yaml
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ls docker_images/src
cfg.py  darknet.py  dataset.py  image.py  MeshPly.py  prepare.py  project.py  region_loss.py  train.py  utils.py  valid.py
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ./build.sh
Sending build context to Docker daemon  3.386MB
Step 1/14 : FROM nvidia/cuda:11.1-devel-ubuntu18.04
11.1-devel-ubuntu18.04: Pulling from nvidia/cuda
f22ccc0b8772: Downloading [============>                                      ]  6.695MB/26.71MB
3cf8fb62ba5f: Verifying Checksum
e80c964ece6a: Download complete
8a451ac89a87: Downloading [========================================>          ]  6.036MB/7.232MB
c563160b1f64: Downloading [=>                                                 ]  229.4kB/10.79MB
596a46902202: Waiting
aa0805983180: Pulling fs layer
5718c3da35a0: Waiting
```

```
Step 13/14 : COPY docker_images/src/*.py                /ssp/
 ---> d0c18eda4d41
Step 14/14 : CMD python valid.py          --datacfg data/sample/sample.data
up.weights
 ---> Running in 87f629f809f1
Removing intermediate container 87f629f809f1
 ---> af39f2069b9a
Successfully built af39f2069b9a
Successfully tagged nia-ssp:1.0
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$
```

```
seongheum@vip-02: ~/Workspa
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ docker images
REPOSITORY    TAG                       IMAGE ID       CREATED          SIZE
nia-ssp       1.0                       af39f2069b9a   14 minutes ago   16.1GB
nvidia/cuda   11.1-devel-ubuntu18.04     2e6eddb41f77   12 months ago    4.74GB
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$
```

도커이미지 사용 방법 (참고)


```
seongheum@vip-02: ~/Workspace/NIA-3DObj/nia-ssp-docker
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ls test_datasets/
030102.zip  050202.zip  050311.zip  060108.zip  060211.zip  070308.zip  070605.zip  070611.zip  070708.zip  070911.zip  100205.zip
050110.zip  050210.zip  050312.zip  060201.zip  060302.zip  070403.zip  070608.zip  070702.zip  070710.zip  090105.zip  100211.zip
050201.zip  050305.zip  060106.zip  060207.zip  070205.zip  070409.zip  070610.zip  070704.zip  070902.zip  090206.zip
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ cat run.sh
#!/bin/bash

TESTCASE=("030102" "050110" "050201" "050202" "050210" "050305" "050311" "050312" "060106" "060108" "060201" "060207" "060211" "060302" "070205" "070308" "070403" "070409" "0706
05" "070608" "070610" "070611" "070702" "070704" "070708" "070710" "070902" "070911" "090105" "090206" "100205" "100211")

if [ $1 == "all" ]; then
        # RUN ALL
        for i in ${TESTCASE[@]}
        do
                eval "./prepare.sh ${i}"
                eval "./test.sh ${i}"
        done
else
        for i in ${TESTCASE[@]}
        do
                if [ $1 -eq "${i}" ]; then
                        eval "./prepare.sh ${i}"
                        eval "./test.sh ${i}"
                fi
        done
fi
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ./run.sh all
```

전체 실행

선택 실행

테스트 목록 (21.12.31)

- S3 Browser를 활용하여 평가용 데이터셋 다운로드. 테스트 목록 확인.
- 테스트 목록 전체 실행, 또는 객체 ID별 실행 가능.

> ./run.sh all

> ./run.sh 070308

도커이미지 사용 방법 (Quick start)


```
seongheum@vip-02:~/Workspace/TTA$ cd nia-ssp
seongheum@vip-02:~/Workspace/TTA/nia-ssp$ wget https://www.dropbox.com/s/o16mx914up6oen2/nia-ssp.tar?dl=0 -O docker_images/nia-ssp.tar
--2022-02-15 11:50:31--  https://www.dropbox.com/s/o16mx914up6oen2/nia-ssp.tar?dl=0
Resolving www.dropbox.com (www.dropbox.com)... 162.125.84.18, 2620:100:6034:18::a27d:5412
Connecting to www.dropbox.com (www.dropbox.com)|162.125.84.18|:443... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: /s/raw/o16mx914up6oen2/nia-ssp.tar [following]
--2022-02-15 11:50:31--  https://www.dropbox.com/s/raw/o16mx914up6oen2/nia-ssp.tar
Reusing existing connection to www.dropbox.com:443.
HTTP request sent, awaiting response... 302 Found
Location: https://uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com/cd/0/inline/BftnR_46c_nlkxRllFIBkcDNY6D1SqieGXPXREykFnbORUV5CQ-tD
rgLh_2p1Qn_JiLNdEbB5GY2ie4pawjnME7lms0JhRmrLg-nRDarrfp-oRTIwE/file# [following]
--2022-02-15 11:50:32--  https://uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com/cd/0/inline/BftnR_46c_nlkxRllFIBkcDNY6D1SqieGXPXRE
lYd57bjoON5UGtkrgLh_2p1Qn_JiLNdEbB5GY2ie4pawjnME7lms0JhRmrLg-nRDarrfp-oRTIwE/file
Resolving uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com (uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com)... 162.125.84.15
Connecting to uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com (uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com)|162.125.84.1
HTTP request sent, awaiting response... 302 Found
Location: /cd/0/inline2/BftlO0nDoQUOX8kKzmpTZVOLaMLAYzC2_UrjlnFmB2sR3rNpyN1buQN2khQWoL5WUNSuz4xGXCUUSwRQQDhYK1S3FpOevPJUCtojxEOXiKSI8qGtrI
qCTLTXjaEQNdz4Sq1E7Uu3tsi2pBcZ5M-pz8avYe9qctxwUbSTVEghShTA2L3IyNRLnW39tfKvPUsr20SUMz2xF0sbGDiVokavmIyR1wyFXDhPrhDM1X5NQ13jCbqB8UkkTpeWznAj
yPVRdYVEIT3Y_7AoNOQPMKC3nqsIEsAD3wKND6FAIdUZ0sADNVBl5DpapBI/file [following]
--2022-02-15 11:50:33--  https://uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com/cd/0/inline2/BftlO0nDoQUOX8kKzmpTZVOLaMLAYzC2_Urjl
USwRQQDhYK1S3FpOevPJUCtojxEOXiKSI8qGtrIDeZZwdi1V0LEPUgzhsnVOngfiY5xLLWcgWUCjRqCTLTXjaEQNdz4Sq1E7Uu3tsi2pBcZ5M-pz8avYe9qctxwUbSTVEghShTA2L3
IyR1wyFXDhPrhDM1X5NQ13jCbqB8UkkTpeWznAjyvwxC4TQBH8NKPU6JAy81CCND97_6NqwgoLPM2yPVRdYVEIT3Y_7AoNOQPMKC3nqsIEsAD3wKND6FAIdUZ0sADNVBl5DpapBI/f
Reusing existing connection to uc94c00f1582858e1c4e581a6fc6.dl.dropboxusercontent.com:443.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [application/x-tar]
Saving to: ‘docker_images/nia-ssp.tar’

docker_images/nia-ssp.tar          [                                <=>                 ]  15.07G  5.43MB/s    in 48m 29s

2022-02-15 12:39:02 (5.30 MB/s) - ‘docker_images/nia-ssp.tar’ saved [16176787968]
```

도커이미지 사용 방법 (Quick start)


```
seongheum@vip-02:~/Workspace/TTA/nia-ssp$ docker images
REPOSITORY   TAG       IMAGE ID   CREATED   SIZE
seongheum@vip-02:~/Workspace/TTA/nia-ssp$ docker load -i docker_images/nia-ssp.tar
b43408d5f11b: Loading layer [==================================================>]  65.62MB/65.62MB
23135df75b44: Loading layer [==================================================>]  15.87kB/15.87kB
fe6d8881187d: Loading layer [==================================================>]  3.072kB/3.072kB
cd37cd672bd2: Loading layer [==================================================>]  17.14MB/17.14MB
7a2f30aca740: Loading layer [==================================================>]   32.7MB/32.7MB
ad5b6813b3ac: Loading layer [==================================================>]  3.072kB/3.072kB
63c72fb01f89: Loading layer [==================================================>]  2.385GB/2.385GB
9f70bc5acecf: Loading layer [==================================================>]  2.247GB/2.247GB
ed750540b663: Loading layer [==================================================>]  426.7MB/426.7MB
e8a74847eb13: Loading layer [==================================================>]   39.9MB/39.9MB
5299080e35db: Loading layer [==================================================>]  256.4MB/256.4MB
3918d75aa0bb: Loading layer [==================================================>]  2.048kB/2.048kB
a28025a6e9bd: Loading layer [==================================================>]  4.096kB/4.096kB
eb816c437934: Loading layer [==================================================>]  10.71GB/10.71GB
06a622e4ff43: Loading layer [==================================================>]  144.4kB/144.4kB
Loaded image: nia-ssp:1.0
seongheum@vip-02:~/Workspace/TTA/nia-ssp$ docker images
REPOSITORY   TAG       IMAGE ID       CREATED         SIZE
nia-ssp      1.0       a4e41623bbfc   32 hours ago    16.1GB
seongheum@vip-02:~/Workspace/TTA/nia-ssp$
```

도커이미지 사용 방법 (Quick start)


```
seongheum@vip-02:~/Workspace/TTA/nia-ssp$ ./run.sh 070308
mkdir: created directory 'test_datasets'
prepare 070308
wget $ZIP_070308 -O test_datasets/070308/070308.zip
--2022-02-15 12:47:57--  https://www.dropbox.com/s/x278nx4yxc01c9r/070308.zip?dl=0
Resolving www.dropbox.com (www.dropbox.com)... 162.125.84.18, 2620:100:6034:18::a27d:5412
Connecting to www.dropbox.com (www.dropbox.com)|162.125.84.18|:443... connected.
HTTP request sent, awaiting response... 301 Moved Permanently
Location: /s/raw/x278nx4yxc01c9r/070308.zip [following]
--2022-02-15 12:47:57--  https://www.dropbox.com/s/raw/x278nx4yxc01c9r/070308.zip
Reusing existing connection to www.dropbox.com:443.
HTTP request sent, awaiting response... 302 Found
Location: https://ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com/cd/0/inline/BftnvRYTcOnY_FLFJIo-1h130D7AbfXEp67qWVUPlm9vhMuCa2Clvk8Gs8doAUgwuW9WQupSPc2uGRadOlqDNeUUnIO
zonTx8hmnGbU3Ka7VjtiF4Xpsygb_kcp-iedABI4mUeasbe1zpXqsR5t9iIqg/file# [following]
--2022-02-15 12:47:57--  https://ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com/cd/0/inline/BftnvRYTcOnY_FLFJIo-1h130D7AbfXEp67qWVUPlm9vhMuCa2Clvk8Gs8doAUgwuW9WQupSPc2u
GRadOlqDNeUUnIOzonTx8hmnGbU3Ka7VjtiF4Xpsygb_kcp-iedABI4mUeasbe1zpXqsR5t9iIqg/file
Resolving ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com (ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com)... 162.125.84.15, 2620:100:6034:15::a27d:540f
Connecting to ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com (ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com)|162.125.84.15|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: /cd/0/inline2/BfuslzJPldN7rT48BDLLSmLxj3x8DqPav3oTlKIXmSFzloTIu8rZX-_Dab-31f-ClKL_HhJ5rdHdfWxnH8_BsfZH1lq_Bn_rkM_BXaxBisi0D8CJzgPaOoaeKOomUoTAdFU-ygFyB6gzxxgINhwrtV_d
ibFsnooH6fSyNuNxd8J3mLGHbMZ5gaa2woVoQQbnTS0reagmoHt2UQiWjphYnjXea5CjuMsRTWzVwzI22OJJZ16EwB1U3maBYLAJcoJTIH7BmbolNvb3XD-VyPF-gGV4laGmdMMuc9_cwgBD3DJeWmyyIx2boxkQWeDJbdtIAkuO8t02
3GL9_hqffsyjPZ-RycQUL1BK3wwMRRcilnZVoGK94FtUBtUNW1Bu8sb-OA0/file [following]
--2022-02-15 12:47:58--  https://ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com/cd/0/inline2/BfuslzJPldN7rT48BDLLSmLxj3x8DqPav3oTlKIXmSFzloTIu8rZX-_Dab-31f-ClKL_HhJ5rdH
dfWxnH8_BsfZH1lq_Bn_rkM_BXaxBisi0D8CJzgPaOoaeKOomUoTAdFU-ygFyB6gzxxgINhwrtV_dibFsnooH6fSyNuNxd8J3mLGHbMZ5gaa2woVoQQbnTS0reagmoHt2UQiWjphYnjXea5CjuMsRTWzVwzI22OJJZ16EwB1U3maBYLA
JcoJTIH7BmbolNvb3XD-VyPF-gGV4laGmdMMuc9_cwgBD3DJeWmyyIx2boxkQWeDJbdtIAkuO8t023GL9_hqffsyjPZ-RycQUL1BK3wwMRRcilnZVoGK94FtUBtUNW1Bu8sb-OA0/file
Reusing existing connection to ucfbaf361873e14db8475be67f7b.dl.dropboxusercontent.com:443.
HTTP request sent, awaiting response... 200 OK
Length: unspecified [application/zip]
Saving to: ‘test_datasets/070308/070308.zip’

test_datasets/070308/070308.zip               [                                    <=>                                 ]   1.35G  5.39MB/s    in 4m 23s

2022-02-15 12:52:22 (5.27 MB/s) - ‘test_datasets/070308/070308.zip’ saved [1454876797]

Archive:  070308.zip
  inflating: masks/070308_000001.png
  inflating: masks/070308_000002.png
  inflating: masks/070308_000003.png
  inflating: masks/070308_000004.png
  inflating: masks/070308_000005.png
  inflating: masks/070308_000006.png
  inflating: masks/070308_000007.png
  inflating: masks/070308_000008.png
  inflating: masks/070308_000009.png
  inflating: masks/070308_000010.png
  inflating: masks/070308_000011.png
```

도커이미지 사용 방법 (Quick start)


```
[#0223] 0868: 4.71 (pixel dist.), 0.96 (IoU score)
[#0224] 0591: 6.69 (pixel dist.), 0.94 (IoU score)
[#0225] 0960: 7.19 (pixel dist.), 0.94 (IoU score)
[#0226] 1115: 8.40 (pixel dist.), 0.94 (IoU score)
[#0227] 0578: 6.67 (pixel dist.), 0.93 (IoU score)
[#0228] 0230: 5.07 (pixel dist.), 0.94 (IoU score)
[#0229] 1152: 7.66 (pixel dist.), 0.91 (IoU score)
[#0230] 0677: 4.87 (pixel dist.), 0.95 (IoU score)
[#0231] 0484: 4.47 (pixel dist.), 0.97 (IoU score)
[#0232] 0152: 3.88 (pixel dist.), 0.95 (IoU score)
[#0233] 0933: 8.25 (pixel dist.), 0.86 (IoU score)
[#0234] 0754: 8.04 (pixel dist.), 0.91 (IoU score)
[#0235] 0749: 4.41 (pixel dist.), 0.95 (IoU score)
[#0236] 0692: 4.38 (pixel dist.), 0.98 (IoU score)
[#0237] 0182: 3.56 (pixel dist.), 0.95 (IoU score)
[#0238] 0467: 6.50 (pixel dist.), 0.96 (IoU score)
[#0239] 0986: 6.88 (pixel dist.), 0.94 (IoU score)
2022-02-15 04:20:10 Results of 070308 (2022-02-15 04:20:10.852802):
2022-02-15 04:20:10    Mean 2D Err. (Pixel Dist.) = 6.70 pix.
2022-02-15 04:20:10    Acc. using  5 px. 2D Projection = 32.50%
2022-02-15 04:20:10    Acc. using 10 px. 2D Projection = 89.17%
2022-02-15 04:20:10    Acc. using 15 px. 2D Projection = 97.92%
2022-02-15 04:20:10    Acc. using 20 px. 2D Projection = 99.58%
2022-02-15 04:20:10    Acc. using Intersection Of Union (IoU, convex) = 100.00%
2022-02-15 04:20:10    Acc. using Intersection Of Union (IoU > 0.25) = 100.00%
2022-02-15 04:20:10    Acc. using Intersection Of Union (IoU > 0.50) = 100.00%
2022-02-15 04:20:10    Acc. using Intersection Of Union (IoU > 0.75) = 70.00%
2022-02-15 04:20:10 Reproj. test: 99.58%, IoU test: 100.00%
seongheum@vip-02:~/Workspace/TTA/nia-ssp$
```

성능 분석 / 유효성 검증

평가 수행

```
  inflating: masks/100211_001199.png
  inflating: masks/100211_001200.png
   creating: models/
  inflating: models/model.weights
  inflating: models/yolo-pose.cfg
  inflating: test.txt
  inflating: train.txt
docker run --name=NIA-SSP --runtime=nvidia --rm -v /home/seongheum/Workspace/NIA-3DObj/nia-ssp-docker/test_datasets:/ssp/data -v /home/seongheum/Workspace/NIA-3DObj/nia-ssp-dock
er/experimental_results:/ssp/experimental_results nia-ssp:1.0 python valid.py --datacfg data/100211/100211.data --modelcfg data/100211/models/yolo-pose.cfg --weightfile data/100
211/models/model.weights
2022-01-03 10:29:18 Results of 100211 (2022-01-03 10:29:18.818820)
2022-01-03 10:29:18    Mean Err. (Pixel Dist.) = 7.78 pix.
2022-01-03 10:29:18    Acc. using 10 px 2D Projection = 78.33%
2022-01-03 10:29:18    Acc. using Intersection Of Union (IoU) = 100.00%
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$
```

Data ID	x0-GT	y0-GT	x1-GT	y1-GT	x2-GT	y2-GT	x3-GT	y3-GT	x4-GT	y4-GT	x5-GT	y5-GT	x6-GT	y6-GT	x7-GT	y7-GT	x8-GT	y8-GT	x0-predict	y0-predict	x1-predict	y1-predict	x2-predict	y2-predict	x3-predict	y3-predict	x4-predict	y4-predict	x5-predict	y5-predict	x6-predict	y6-predict	x7-predict	y7-predict	x8-predict	y8-predict	pixel error	2D projec	IoU	IoU score
100211_0	734	353	793	445	790	340	660	430	656	329	812	365	807	273	686	355	683	262	737.3	352.1	783.8	442.8	780.9	340.1	662.1	425	659.8	329.8	806.9	361.6	805	271.8	688.6	348.8	691.6	261.7	3.85	True	0.95	True
100211_0	679	352	643	434	626	343	620	366	611	288	747	413	734	324	724	346	713	271	679.5	350.6	634.3	428	640.4	346.7	611	353.1	616	293.2	750.3	402.3	728.2	328.6	719	332.4	703.2	277.4	7.31	True	0.9	True
100211_0	679	289	641	290	638	204	755	295	757	208	605	365	601	263	741	374	739	271	681.9	292	642.9	287	647.2	204.2	756	308.4	754.9	219.6	603.3	356.7	610.5	253.3	730.6	384.5	727.8	276.5	5.84	True	0.93	True
100211_0	676	287	687	283	680	194	756	319	752	228	603	340	597	245	677	380	674	280	663.6	282.8	644.7	284.5	646	197.4	742.8	310.9	743.6	217.7	587.2	337.6	586.4	238.5	693.4	369.4	689.8	264	14.75	False	0.88	True
100211_0	664	284	582	389	578	252	581	312	578	180	750	389	746	252	749	312	741	180	663.6	284.1	586.9	390.8	576.2	241.6	598.8	310.1	593	175.8	748.9	389.9	740.1	240.7	754.2	308.9	747.1	171.2	7.3	True	0.95	True
100211_0	701	289	703	288	703	200	794	332	792	231	614	328	608	233	704	379	701	266	696	285.5	687.4	289.5	688.3	194.1	773.3	323.2	776.4	221.4	615.4	338.2	615.3	233.5	708.9	377.2	707.8	265.3	6.95	True	0.91	True
100211_0	669	327	612	412	607	324	621	311	620	242	725	411	722	324	732	311	731	243	677	332.2	603.9	404.6	609.6	317.7	627.5	316.1	629.1	252.3	722.4	408.8	709.4	322.4	735	317.4	724.4	257.9	5.25	True	0.9	True
100211_0	676	314	750	337	743	269	688	398	683	323	668	290	665	230	604	342	602	277	680	314	748.5	336.2	740	265.2	688.5	389	687.8	305.9	676.3	304.4	673	240.1	613.1	350.6	616.8	275.4	7.78	True	0.91	True
100211_0	707	326	678	428	674	335	626	333	625	263	789	378	789	290	731	293	732	225	703.8	330.9	676	422	673.7	327.7	626.4	350.3	626.5	270.7	787.5	380.1	775.8	294	728.9	314.4	722.6	242	9.69	True	0.92	True
100211_0	643	361	639	353	636	283	711	378	706	310	580	401	575	328	652	439	647	358	639.9	357.5	629.3	340.3	625.2	275.7	709.4	374.9	707.3	305.7	574.7	400.5	570	327.5	662.1	441.3	655.4	365.5	4.91	True	0.93	True
100211_0	745	305	813	322	816	234	790	396	792	302	707	302	707	215	675	372	677	279	746	301.9	815.1	317.2	816.5	236.6	784.5	387.4	788.4	290.4	710.1	295.2	716.3	217.4	670.6	359.4	675.1	267.2	7	True	0.93	True
100211_0	648	300	584	306	582	218	709	304	700	216	586	385	584	296	714	383	708	295	642	294.3	592.9	292.2	596.9	208.8	710.1	303.9	707.5	217.9	570.3	366.5	573.6	267	699.6	381.3	696.2	277.9	12	False	0.89	True
100211_0	658	359	708	337	683	282	722	404	699	344	602	371	594	310	623	437	610	372	654.8	355	688	340.3	679.2	276.5	721	404.3	718.1	332.1	592.6	368.5	584.4	299.6	623.9	434.7	618.2	360.4	8.06	True	0.93	True

로그 파일

- **테스트 케이스별로 다음의 정보를 확인**
  - Timestamp (서울 표준시 기록), 실행 명령어 (명령어 history),
  - 개별 결과값, 최종 결과값, 최종 결과 계산 시 사용한 값 (reprojection error, IoU score)
- **reprojection 기반 정확도, IoU 기반 정확도로 위치/자세 추정 결과에 대해 성능 분석**
  - 로그 파일에는 GT에서 제공된 큐브 꼭지점 좌표 위치와 모델에서 예측한 위치를 비교
  - 테스트 영상 별로 평균 픽셀 오차와 IoU 스코어를 비교하여 목표치 도달 여부 판단

성능 분석 / 유효성 검증


```
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ls experimental_results/
030102.csv  050201.txt  050305.csv  050312.txt  060201.csv  060211.txt  070308.csv  070409.txt  070610.csv  070702.txt  070710.csv  070911.txt  100205.csv
030102.txt  050202.csv  050305.txt  060106.csv  060201.txt  060302.csv  070308.txt  070605.csv  070610.txt  070704.csv  070710.txt  090105.csv  100205.txt
050110.csv  050202.txt  050311.csv  060106.txt  060207.csv  060302.txt  070403.csv  070605.txt  070611.csv  070704.txt  070902.csv  090105.txt  100211.csv
050110.txt  050210.csv  050311.txt  060108.csv  060207.txt  070205.csv  070403.txt  070608.csv  070611.txt  070708.csv  070902.txt  090206.csv  100211.txt
050201.csv  050210.txt  050312.csv  060108.txt  060211.csv  070205.txt  070409.csv  070608.txt  070702.csv  070708.txt  070911.csv  090206.txt
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$
```

```
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ ./prepare.sh report
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$ cat report.txt
report
030102 8.62 83.33 100.00
050110 3.71 100.00 100.00
050201 4.11 99.58 100.00
050202 6.42 91.25 100.00
050210 3.35 100.00 100.00
050305 11.91 64.58 100.00
050311 30.64 42.44 87.82
050312 5.24 96.49 100.00
060106 4.03 100.00 100.00
060108 7.80 78.75 100.00
060201 4.55 97.08 100.00
060207 6.41 95.00 99.58
060211 5.92 90.83 100.00
060302 6.23 93.33 100.00
070205 10.72 70.83 100.00
070308 6.70 89.17 100.00
070403 7.12 92.80 98.31
070409 2.46 100.00 100.00
070605 6.52 87.50 100.00
070608 7.26 91.67 100.00
070610 4.27 97.90 100.00
070611 7.05 84.58 100.00
070702 2.12 99.58 100.00
070704 4.02 97.08 100.00
070708 10.28 81.67 100.00
070710 4.82 97.50 100.00
070902 10.83 68.75 100.00
070911 36.99 89.50 95.38
090105 2.56 100.00 100.00
090206 3.70 99.17 100.00
100205 4.24 97.48 100.00
100211 7.78 78.33 100.00
seongheum@vip-02:~/Workspace/NIA-3DObj/nia-ssp-docker$
```

카테고리별 학습 유효성 검증 결과

Cat. ID	Rep. Test	IoU Test
0101	40.93	99.40
0102	51.76	100.00
0301	94.68	99.72
0302	91.75	99.78
0303	90.91	94.75
0403	91.85	100.00
0404	92.35	99.86
0501	86.00	99.30
0502	91.74	99.13
0503	91.02	98.22
0601	91.06	96.55

Cat. ID	Rep. Test	IoU Test
0602	98.72	99.58
0603	98.77	99.58
0701	86.47	100
0702	90.69	99.50
0703	82.24	99.38
0704	92.74	99.52
0705	97.98	99.66
0706	91.79	99.35
0707	96.36	99.73
0708	83.94	99.02
0709	88.97	99.35

Cat. ID	Rep. Test	IoU Test
0710	94.51	98.89
0801	92.11	100
0901	98.04	99.94
0902	86.96	99.73
0903	92.03	99.66
0904	95.83	99.64
0905	96.74	100
1001	55.53	98.31
1002	90..49	100
1101	96.36	99.09
평균	**88.17**	**99.27**

> prepare.sh report → 평가용 데이터셋 목록의 최종 결과 값을 report.txt에 정리