# Towards Scene Understanding for Autonomous Operations on Airport Aprons Supplementary Material

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The following sections provide additional details regarding dataset statistics and evaluation results complementing the information in the main paper.

## A  Dataset Statistics

A statistical overview of all annotated image parameters is given in Table 1. Additionally, the full labeling scheme of all dataset variants is presented in Table 2 along with the numbers of instances and object occurrence for each class.

**Table 1.** Absolute numbers of instances for each parameter presented in Fig. 4 of the main paper

|  |  | Instances |
|---|---|---:|
| **Time of Day** | Day | 76149 |
|  | Twilight | 41049 |
|  | Night | 51975 |
| **Lighting** | Sunny | 49994 |
|  | Diffuse | 64731 |
| **Degradation** | Low | 137943 |
|  | High | 31348 |
| **Occlusion** | True | 153851 |
|  | False | 15440 |
| **Object Size** | Small | 100180 |
|  | Medium | 30554 |
|  | Large | 38557 |
| **Atmosphere** | Clear | 158304 |
|  | Rain | 8295 |
|  | H. Rain | 856 |
|  | Fog | 1525 |
|  | Snow | 0 |

**Table 2.** Overview of all object classes in the original Apron dataset *Fine*, included classes in the *Top* and mapping scheme for the *Coarse* variants. The right-most columns list the total numbers of instances for each class and images containing them

| Fine | Top | Coarse | Instances | Occurrences |
|---|---|---|---|---|
| Safety Vehicle | ✓ | Safety Vehicle | 1179 | 1094 |
| Business Jet | ✓ | Business Jet | 9623 | 4384 |
| Cargo Airplane | ✓ | Cargo Airplane | 5122 | 4322 |
| Passenger Jet | ✓ | | 1382 | 999 |
| Common Aircraft | ✓ | Common Aircraft | 3037 | 1847 |
| Container Trolley | ✓ | | 778 | 340 |
| Container Trolley Type A | ✓ | Container Trolley | 27837 | 5806 |
| Container Trolley Type B | ✓ | | 4697 | 3126 |
| Container Trolley Type C | | | 199 | 85 |
| Conveyor Vehicle | ✓ | Conveyor Vehicle | 1933 | 1430 |
| Helicopter | | Helicopter | 397 | 346 |
| Rescue Helicopter | | | 147 | 142 |
| Loading Ramp | ✓ | Loading Ramp | 1049 | 1048 |
| Loading Vehicle | ✓ | Loading Vehicle | 3754 | 3136 |
| Other Objects | | Other Objects | 755 | 739 |
| Ambulance Vehicle | | | 3 | 3 |
| Cleaning Vehicle | | | 78 | 45 |
| Fire Truck | ✓ | | 917 | 876 |
| Forklift | | | 116 | 96 |
| Other Vehicles | ✓ | Other Vehicles | 6770 | 4042 |
| Sanitary Truck | ✓ | | 2403 | 2145 |
| Snowplow | | | 123 | 120 |
| Standard Truck | | | 723 | 597 |
| Tow Vehicle | | | 227 | 211 |
| Tractor | | | 133 | 130 |
| Passenger Bus | ✓ | Passenger Bus | 4612 | 2276 |
| Passenger Stairway | ✓ | Passenger Stairway | 6535 | 3963 |
| Person w/ Reflective Vests | ✓ | Person | 11932 | 4104 |
| Person | | | 637 | 386 |
| Standard Car | ✓ | Standard Car | 10287 | 5015 |
| Tank Truck | ✓ | Tank Truck | 1103 | 1068 |
| Taxiing Vehicle | ✓ | Taxiing Vehicle | 6909 | 3982 |
| Traffic Barrier | | Traffic Barrier | 675 | 185 |
| Traffic Cone | | Traffic Cone | 165 | 87 |
| Traffic Cone - Standard | ✓ | | 10271 | 4108 |
| Traffic Cone - Off | ✓ | Traffic Cone Light | 1333 | 487 |
| Traffic Cone - On | ✓ | | 5600 | 1423 |
| Pedestrian Crossing | | Traffic Sign | 120 | 103 |
| Speed Limit 30 | | | 461 | 438 |
| Traffic Sign | | | 193 | 183 |
| Warning Sign | | | 317 | 275 |
| Transport Container | ✓ | Transport Container | 28254 | 6613 |
| Transport Vehicle | ✓ | Transport Vehicle | 6489 | 4461 |

# B    Evaluation details

## B.1    Classification

Tables 3 and 4 show the impact of environmental conditions on classification performance of EfficientNet-B3 as the absolute deviations from overall Recall and Precision values on the corresponding test sets, used as a basis for $f_1$ scores in Table 2 of the main paper. For comparison, Table 5 presents the corresponding top-1 accuracy deviations.

**Table 3.** Average impact of environmental conditions on classification recall

|  | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|  | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | 0.001 | -0.008 | 0.002 | 0.038 | -0.009 | 0.000 | -0.011 | 0.005 | -0.043 |
| **T** | -0.002 | 0.012 | -0.014 | 0.009 | 0.006 | 0.006 | -0.039 | 0.000 | -0.003 |
| **C** | 0.010 | -0.027 | -0.015 | 0.027 | -0.009 | 0.010 | 0.007 | 0.002 | -0.024 |
| **∅** | **0.003** | **-0.008** | **-0.009** | **0.025** | **-0.004** | **0.005** | **-0.014** | **0.002** | **-0.023** |

**Table 4.** Average impact of environmental conditions on classification precision

|  | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|  | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | -0.049 | -0.049 | -0.014 | -0.017 | -0.006 | -0.013 | -0.001 | 0.005 | -0.170 |
| **T** | 0.009 | 0.000 | -0.011 | 0.002 | 0.006 | 0.003 | -0.015 | 0.001 | -0.014 |
| **C** | 0.003 | 0.002 | -0.007 | 0.009 | -0.005 | 0.007 | -0.027 | 0.002 | -0.052 |
| **∅** | **-0.012** | **-0.016** | **-0.011** | **-0.002** | **-0.002** | **-0.001** | **-0.014** | **0.003** | **-0.079** |

**Table 5.** Average impact of environmental conditions on classification top-1 accuracy

|  | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|  | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | 0.007 | -0.003 | -0.006 | 0.013 | -0.003 | 0.003 | -0.014 | 0.002 | -0.043 |
| **T** | 0.008 | -0.006 | -0.008 | 0.009 | -0.002 | 0.004 | -0.020 | 0.002 | -0.033 |
| **C** | 0.005 | -0.005 | -0.005 | 0.011 | -0.006 | 0.006 | -0.024 | 0.001 | -0.025 |
| **∅** | **0.007** | **-0.005** | **-0.006** | **0.011** | **-0.004** | **0.004** | **-0.019** | **0.002** | **-0.034** |

## B.2    Detection

Tables 6, 7 and 8 show the individual results for each model architecture, summarized in Table 5 of the main paper, as the absolute deviation from overall detection *APs* presented in Table 4 of the main paper on the test sets of the *Fine* (F), *Top* (T) and *Coarse* (C) dataset variants.

**Table 6.** Average impact of environmental conditions for the YOLOv5s architecture

|   | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|   | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | 0.048 | -0.005 | -0.007 | 0.048 | 0.098 | 0.006 | -0.004 | 0.001 | 0.083 |
| **T** | 0.002 | 0.013 | 0.004 | 0.003 | -0.002 | 0.002 | -0.016 | 0.002 | -0.025 |
| **C** | 0.019 | -0.009 | -0.003 | 0.027 | -0.012 | 0.010 | -0.034 | 0.002 | -0.035 |
| **∅** | **0.023** | **0.000** | **-0.002** | **0.026** | **0.028** | **0.006** | **-0.018** | **0.002** | **0.008** |

**Table 7.** Average impact of environmental conditions for the YOLOv5m architecture

|   | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|   | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | 0.038 | -0.005 | 0.001 | 0.039 | -0.008 | 0.002 | -0.002 | 0.002 | 0.046 |
| **T** | -0.001 | 0.010 | 0.005 | -0.001 | -0.009 | -0.003 | -0.019 | -0.001 | 0.010 |
| **C** | 0.019 | -0.011 | -0.003 | 0.026 | -0.008 | 0.010 | -0.031 | 0.004 | -0.041 |
| **∅** | **0.019** | **-0.002** | **0.001** | **0.021** | **-0.008** | **0.003** | **-0.017** | **0.002** | **0.005** |

**Table 8.** Average impact of environmental conditions for the YOLOv5l architecture

|   | Time of day | | | Lighting | | Degradation | | Atmosphere | |
|---|---|---|---|---|---|---|---|---|---|
|   | Day | Twilight | Night | Sunny | Diffuse | Low | High | Clear | Rain |
| **F** | 0.030 | -0.003 | 0.003 | 0.024 | -0.010 | -0.002 | 0.013 | 0.002 | 0.045 |
| **T** | 0.007 | 0.069 | 0.007 | -0.003 | 0.011 | 0.006 | -0.029 | 0.000 | -0.042 |
| **C** | 0.009 | 0.001 | -0.003 | 0.022 | -0.010 | 0.008 | -0.025 | 0.003 | -0.047 |
| **∅** | **0.015** | **0.022** | **0.002** | **0.014** | **-0.003** | **0.004** | **-0.014** | **0.002** | **-0.015** |