The background of the slide is a photograph of a Boeing 747-400 aircraft in flight, viewed from a low angle looking up. The aircraft is white with blue and green accents. The text "Boeing 747-400" is visible on the upper fuselage. The aircraft is flying against a cloudy sky.

Charonite

Intelligence. Precision. Reliability.

IDITES Aviation Applications

Charonite

- Charonite is an innovative technology venture developing cutting edge software products and expertise in search engine technology and intelligent transport systems.
- Innovative Technology Company
 - Next Generation Technology
 - High Performance Processing and Terabyte-Scale Distributed Algorithms
 - Operational since 2006
- Locations: Malta, UK, Abu Dhabi, Australia

Charonite Research Areas

- Image Processing Algorithms
- GPU Based Computation
- Position-Based and Situational Awareness Algorithms
- Search Engine Technology
- Software as a Service (SaaS) / Cloud Computing
- Distributed Transaction Processing
- Data Visualisation

Aviation Security Proposal

- Research into advanced tracking and scene analysis of vehicles, persons and aircraft in an airport apron / aviation context
 - Robust multi-object tracking, handling both partial and total occlusions and object egress/ingress handling.
 - GPU-Based processing is utilized to provide significant performance speedup and reduced power consumption compared to traditional CPU-based solutions. Standard CUDA graphics hardware is used to keep costs down.

Aviation Security Proposal

- Cost and Ease of Deployment: CCTV cameras are the only input sensors required for the technology to work. In most airports, these are readily available and are relatively cheap to procure and install, with a simple calibration process taking only a few minutes to run. Algorithms currently can fuse both colour and infrared imagery and use stereoscopic information. Automated PTZ support is currently being researched.
- Ongoing research into handling mobile camera platforms for wider deployment. This is one of the most challenging aspects as it involves the creation of new algorithms that work in realtime during motion of the camera itself.

Background

- Work based on image processing and tracking work done in the past by Charonite and its employees
 - Intelligent Transport Systems (congestion charging, automatic number plate recognition systems and interfacing, car park management, traffic control...)
 - Academic Work (vehicle tracking, crowd tracking, 3D object tracking, face recognition, image similarity)
 - EU Funded Work (AVITRACK project (FP6), core IDITES research (ERDF))
 - EDA Proposals (UAV and Aviation applications of IDITES)

Identification of Targets of Interest



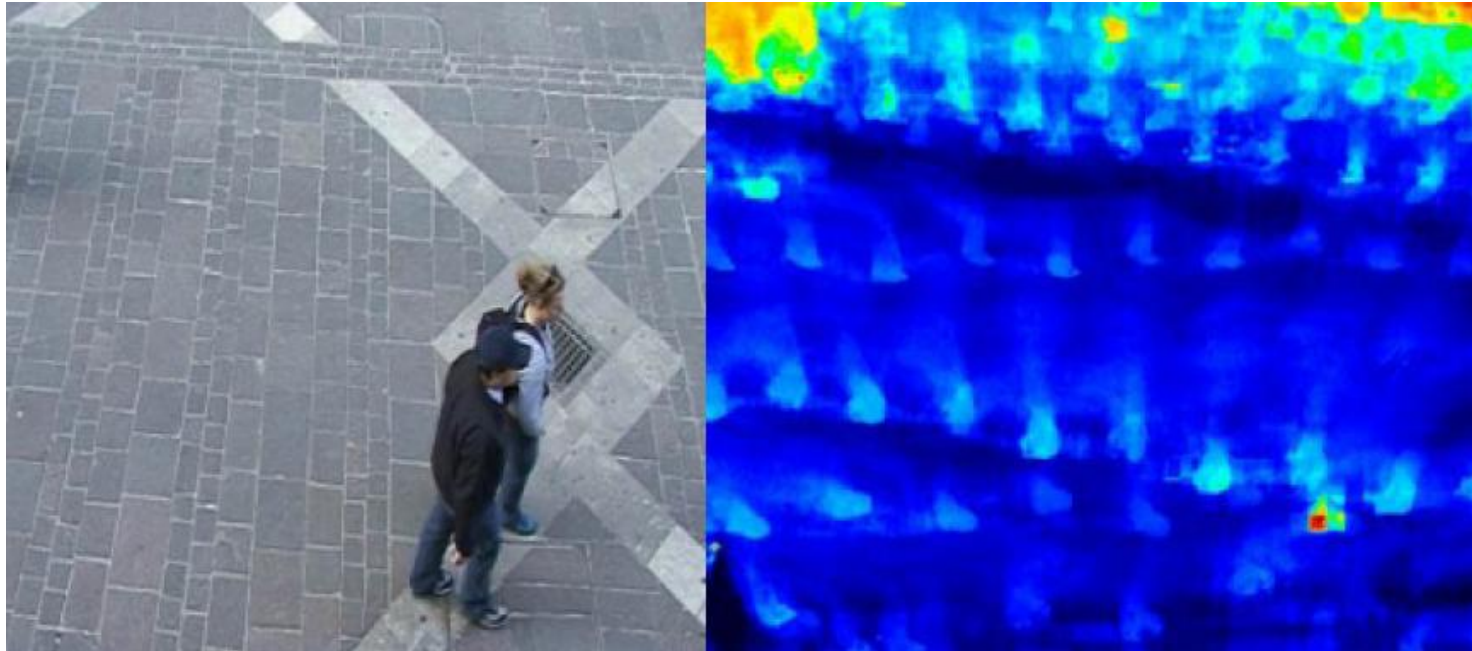
Typical Aviation Scenes can be very cluttered and complex to analyse (video data from AVITRACK project)

Identification of Targets of Interest



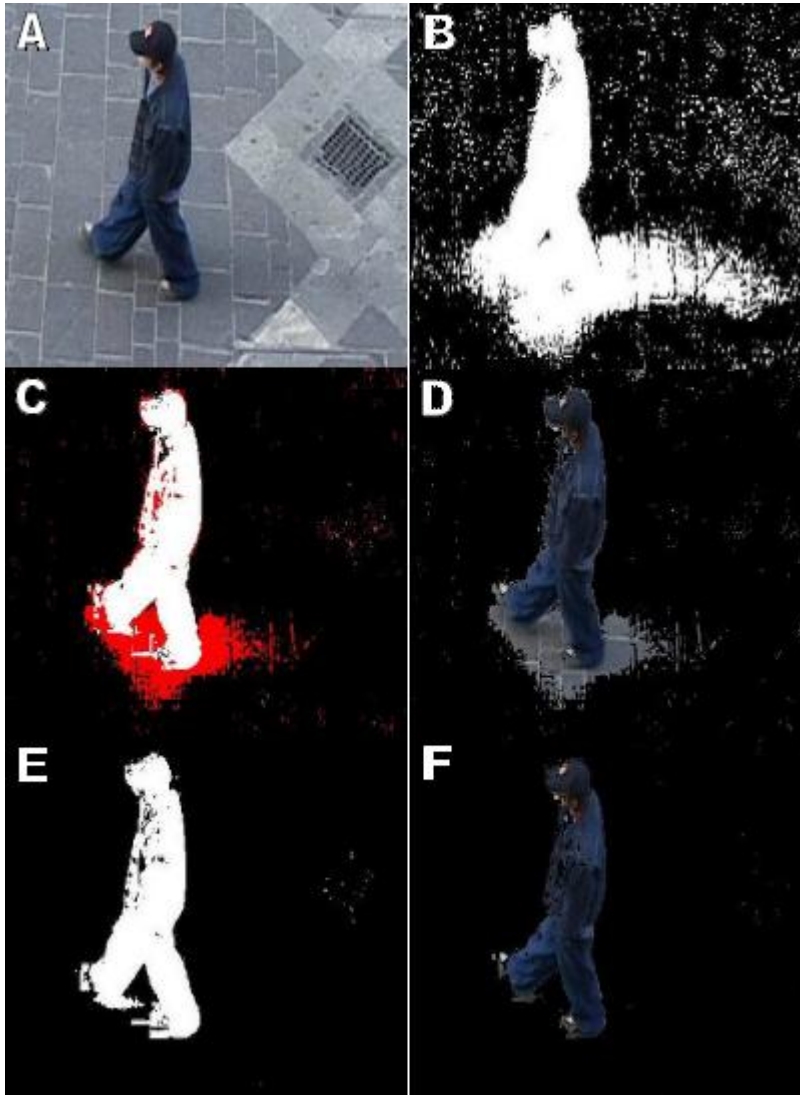
Existing expertise in vehicle and crowd tracking is definitely a pre-requisite!

People and Crowd Tracking



- Crowd tracking experiments in pedestrian areas – showing average heatmap statistics where people walk over time

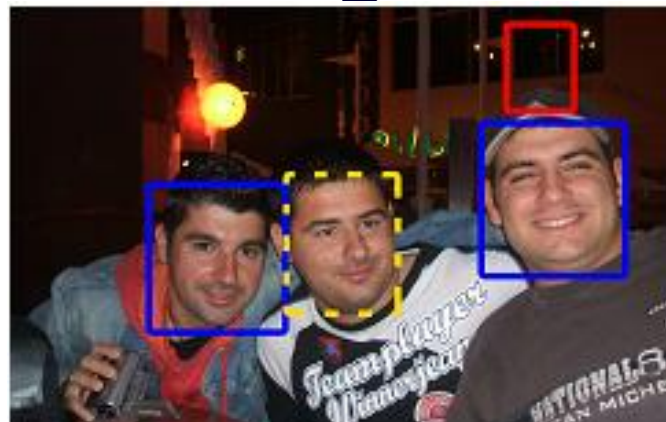
People and Crowd Tracking



- Background subtraction and shadow removal to aid in blob detection and accurate 3D tracking of people
- Ongoing research in deformable templates (similar to London Underground experiments)

People and Crowd Tracking

- Experimental face recognition technology – works also on low resolution pictures taken off the web and with mobile phones.
- Machine learning and automatic adaptation.
- Labelling and recognition of faces in photos.
- Currently experimental part of the IDITES library, not ready for commercial deployment

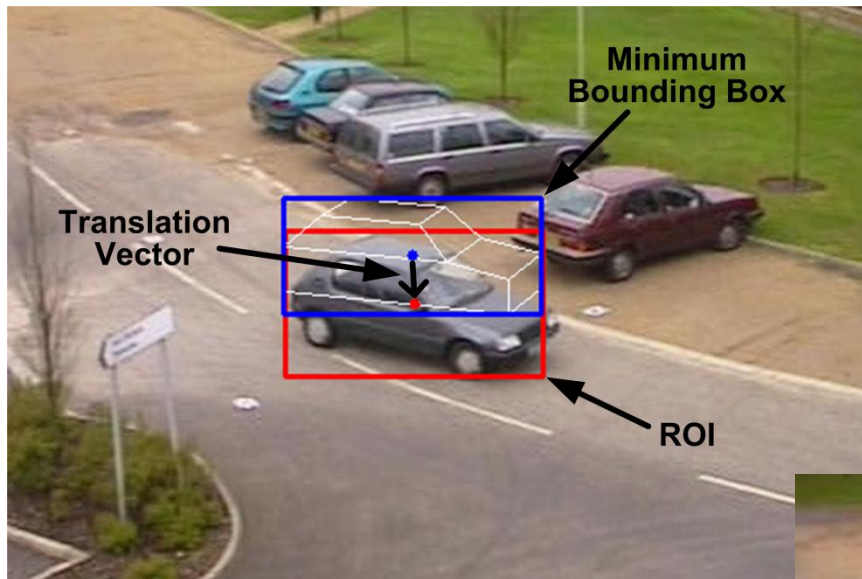


Vehicle Tracking



- Enhanced background analysis for vehicular traffic contexts

Vehicle Tracking



- Fast model fitting using low power GPU based algorithms

- Accurate tracking of vehicular traffic in 3D
- Occlusion handling



Aviation Context Handling

- Handling of typical airport scenarios and aviation contexts
- **Combination of vehicle and people tracking**
- Scenes can get busy once aircraft has stopped at a particular gate, with lots of specialised vehicles and different people swarming around the aircraft to service it quickly
- GPU based computational methods help achieve the processing speeds required to track between 12 to 20 simultaneous objects

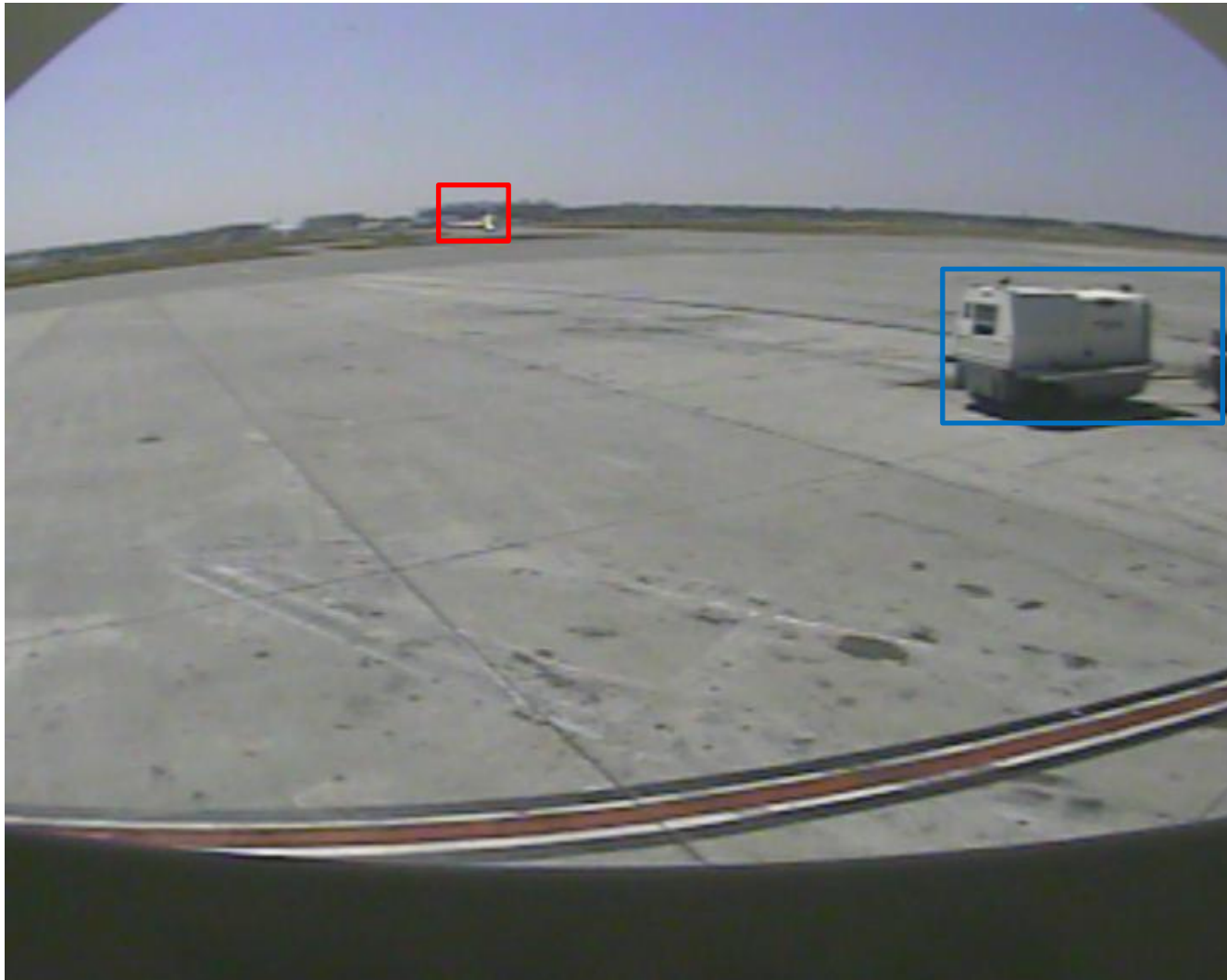
Identification of Targets of Interest



Identification of Targets of Interest



Identification of Targets of Interest



Identification of Targets of Interest



Identification of Targets of Interest

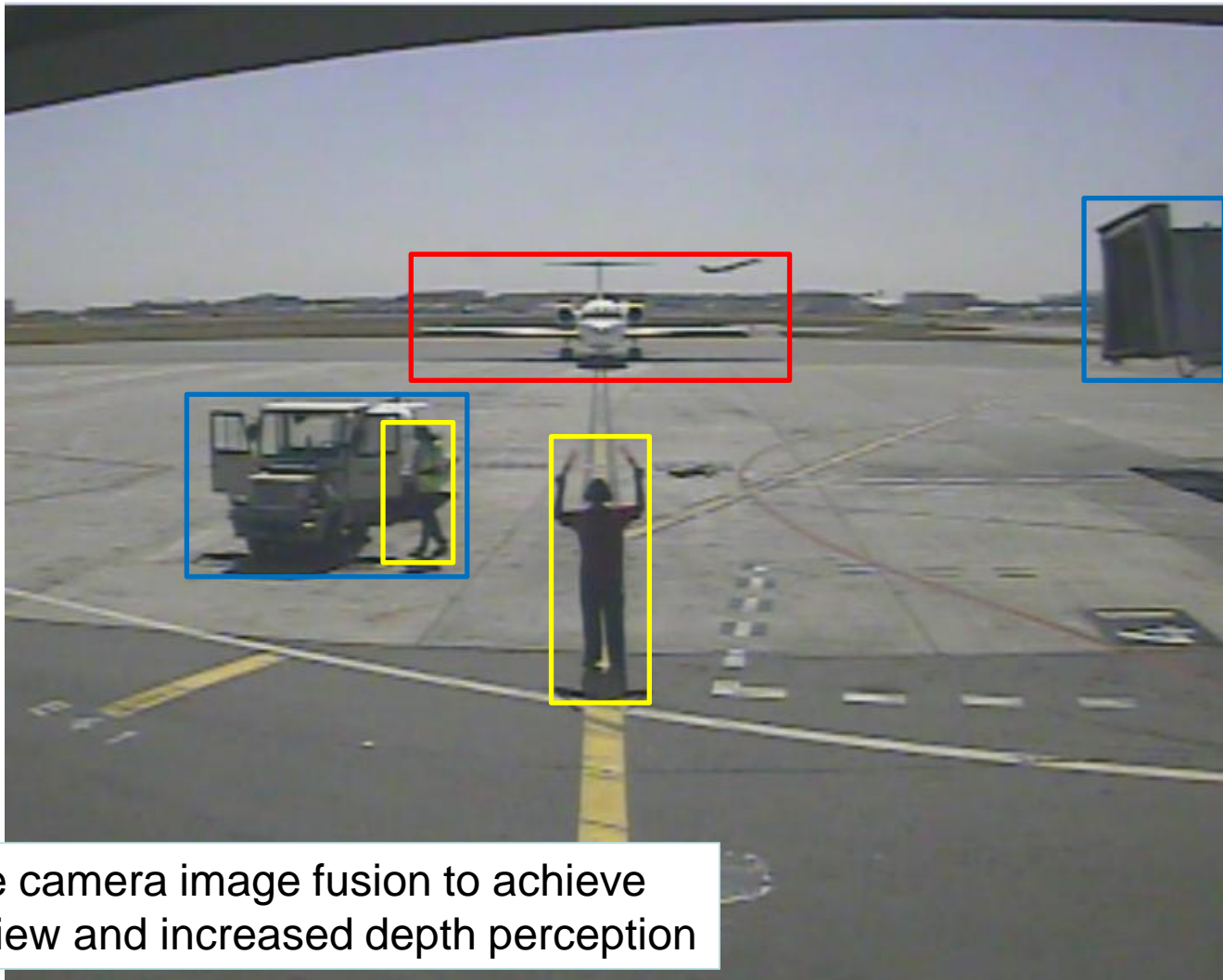


Identification of Targets of Interest



Aircraft tracked automatically as it approaches camera system

Identification of Targets of Interest



Multiple camera image fusion to achieve wider view and increased depth perception

Aviation Context Handling

- Security monitoring to detect unauthorised access and abnormalities – straying away from predetermined normal scripts / ground handling scenarios
- Enhanced safety by detecting potential accidents before they occur, reducing the number of accidents and associated ground support equipment/aircraft repair costs.

Identification of Targets of Interest



Unauthorised personnel or unusual situations are automatically detected from the normal scene

Identification of Targets of Interest



Identification of Targets of Interest



Object egress is handled appropriately with a cache of recently seen objects kept in memory for a configurable amount of time

Identification of Targets of Interest



New object ingress is matched with cache of recently seen objects to maintain link between scenes over time

Identification of Targets of Interest



Identification of Targets of Interest



Alerts can be raised automatically

Identification of Targets of Interest



Prompting personnel to take appropriate checks and actions

3D Models

Various 3D models built for a wide variety of aviation contexts

```
position of the stairs respect to the body2 : x = 0 y = 870 z = 0
position of the cylinder respect to the body2 : x = 0 y = 870 z = 0

f = front
b = back
l = left
r = right
t = top
u = under

*/
/*****/
:::CylinderRel
Cylinder{
  Parameters{
    r Range (-Pi/4 Pi/4)
  }
  Transforms{
    StdMatrix(TransY, 8.7)
    StdMatrix(RotZ, r)
  }
}

:::StairsRel
Stairs{
  Parameters{
    r Range (0 Pi/2)
  }
  Transforms{
    StdMatrix(TransX, -1.7)
    StdMatrix(TransY, 4.5)
    StdMatrix(TransZ, -1.5)
    StdMatrix(RotX, r)
  }
}

/*****/

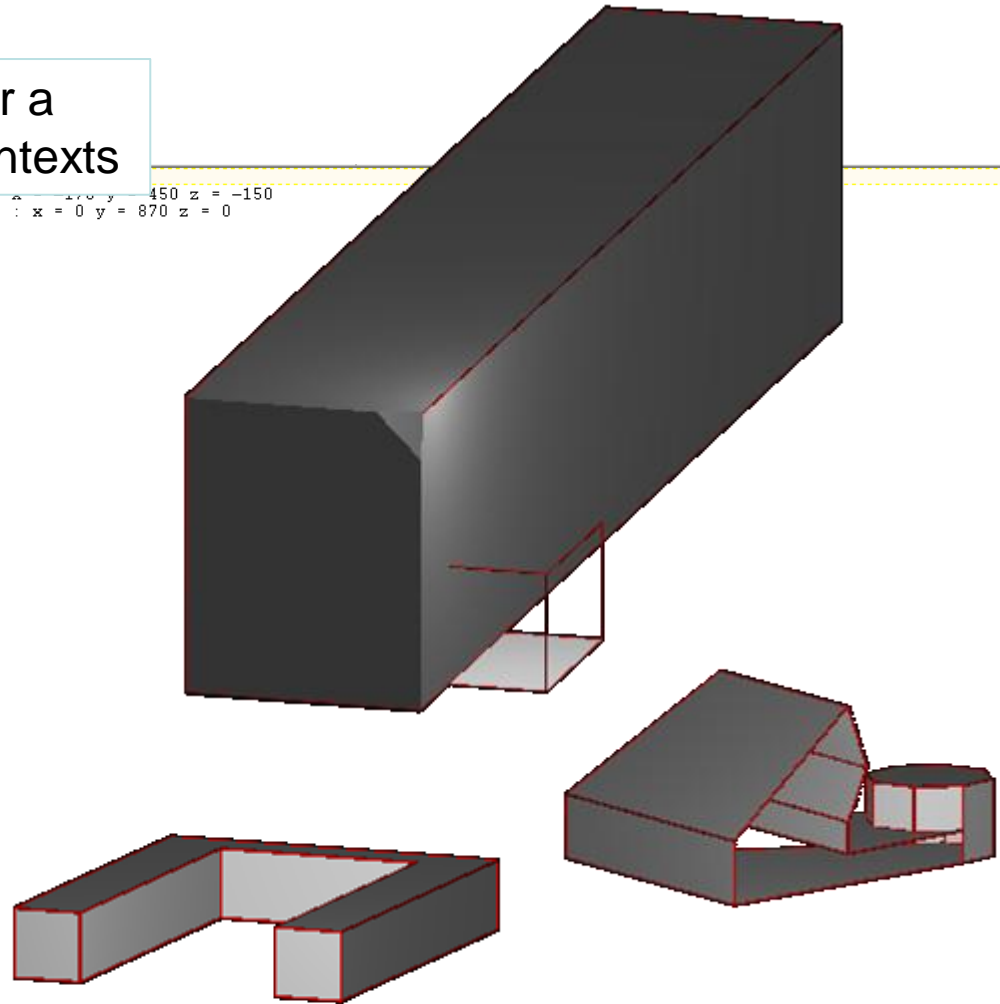
Articulated_Model

Body2      body2.prim
Cylinder   cylinder.prim
Stairs     stairs.prim

RELATIONS

CylinderRel      Cylinder
StairsRel        Stairs

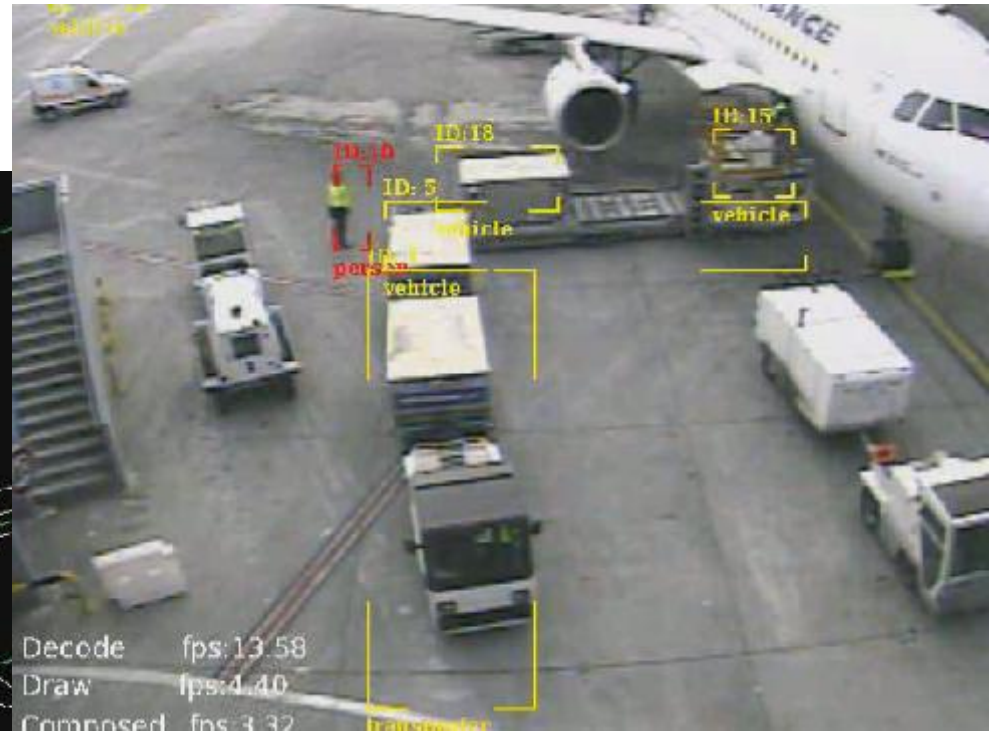
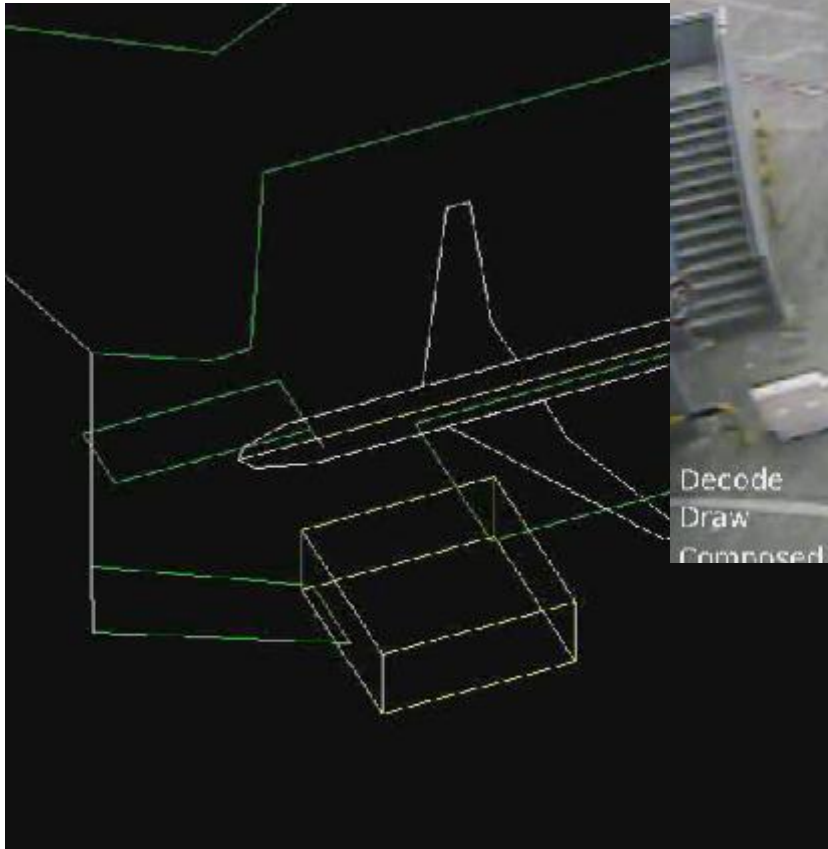
END
```



Aviation Context Handling

- Give an insight in the utilization of ground support equipment and apron areas, allowing management to identify bottlenecks and optimize resource usage.
- Gain information to facilitate maintenance and guide investment planning.
- Using IDITES scene analysis (ongoing research) to understand a given scene and assign it to possible scenarios. Semantic understanding of scenes using AI rule engine.

Synthesis



Data from AVITRACK project serves as a benchmark for scene synthesis and understanding



SCENARIO AIRCRAFT_ARRIVAL_PREPARATION_SCENARIOS

Vehicle: GPU

Person: Handler

Zones: ERA, GPU_Access, Arrival_Preparation

Dynamic Zone: GPU_Door

Vehicle_Arrived_In_ERA

Gpu_Enters_Gpu_Access_Area

Gpu_Stopped_In_Gpu_Access_Area

Handler_Gets_Out_Gpu

Handler_From_Gpu_Deposites_Chocks_Or_Stud

Vehicle_Arrived_In_ERA
Gpu_Enters_Gpu_Access_Area
Gpu_Stopped_In_Gpu_Access_Area
Handler_Gets_Out_Gpu

Scene analysis can handle different preset scenarios by analysing the different events that are occurring in the video stream

Potential Partners

- Charonite provides software solutions and algorithm research and development
- Expertise in applying and selling tracking systems commercially (in operational congestion charge system)
- Good fit / requirements for potential partners:
 - **Low-Power Camera and Sensor suppliers**
 - **Other companies / organisations doing similar research**
 - **Airport companies and aviation companies**

IDITES Aviation Application

- Utilising IDITES tracking library for vehicles and people tracking together with GPU based algorithms in aviation contexts
- Certification issues for use in regulated and restricted zones
- Research in deploying actual commercial quality systems in the field

Contact Information



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