THE PROJECT

LitterDrone

Atlantic from Space Workshop | 23-25/01/2019 | Slide 2
DRONE-BASED IMAGE ACQUISITION
+
COMPUTER BASED IMAGE ANALYSIS
¿WHAT IS MARINE LITTER?

Man made solid waste that, for any cause, are abandoned in marine or coastal environment

SOURCE: PNUMA
LITTERDRONE ORIGIN

- Marine litter **characterization** as a key factor to eradicate them

- Official **monitoring** program for marine litter on beaches (MAPAMA)

- **Standardization** and **automation** of marine litter characterization

SOURCE: Surfrider España
Funded by EU (BLU-LABS Program)

- EASME/EMFF/2016/1.2.1.4

Blue Labs
Innovative Solutions for Maritime Challenges

- Supported by:

- With Collaboration of:

- Partners:

Universidade de Vigo

AEBAM
DROnes & FLIGHTs

LitterDrone
UAV’S & CAMERAS

- 20-50 meters
- Visible
- Multi-spectral
- Thermal
UAV’S & CAMERAS

Visible

Multi-spectral

Thermal

10-15 meters
REAL FLIGHTS
IMAGE ACQUISITION: ORTHO-PHOTO
IMAGE ACQUISITION: ORTHO-PHOTO

Photomodeler: from photos to Ortho-photo (geo-referenced, exact)
Flying on one of the monitored beaches: “playa de Rodas” (Galician Atlantic Islands Maritime-Terrestrial National Park)

Detection of true marine litter and comparison with official data

Flying on another (non monitored) beach

With the collaboration of
REAL FLIGHTS

Flight transects

Flight with individual photo shots labelled
IMAGE PROCESSING

Objects detection with beta version:
sand characterization

IMAGE TYPE: RGB
VISIBLE
CONVENTIONAL CAMERA
SAND CHARACTERIZATION

RGB \rightarrow YCbCr

HSV \rightarrow [Cb, Cr, H, S, a, b]

Recognition:
- 1-NN with K-means prototypes, nearest prototype: $P_{NN}$.
- $\text{Dist}(\text{pixel\_actual}, P_{NN}) < U \Rightarrow $ FONDO.

Normalization [0,1]

K-means with calibration examples
SAND CHARACTERIZATION (method II)

Use of differential components (R-G, R-B, G-B).

Future Lines:
Use of normalized differential indexes: \((C2-C1)/(C1+C2)\)
OBJECT DETECTION

IMAGE TYPE: RGB
VISIBLE, CONVENTIONAL CAMERA
GLOBAL REPORT

FAST & AUTOMATIC
IMAGE SUPERPOSITION
IMAGE SUPERPOSITION: methods

- Manual selection of (at least three control points) and affine transformation.
- Use of geo-referentiation files: scale info + one control point from image origins.
- Manual introduction of scale info + one control point (for displacement).

Future Lines:

- Two control points \(\rightarrow\) definition of two “control vectors” \(\rightarrow\) enough to deduce scale info and displacement.)
OBJECT RECOGNITION

Automatic recognition of more common objects: lids, bottles, cans, sticks... and also auxiliary objects (white targets)
OBJECT RECOGNITION

Object classification

- Regular thickness
  - White targets
  - stakes
  - lids
  - bottles
  - cans
  - fishing nets
  - beach shovel
  - pegs

  Regular radius S.E.

- Small thickness
  - cords
  - sticks
  - signalling wires

  Small radius S.E.
Decision tree is implemented computing discriminant functions. For class $i$, at stage $n$, we take into account feature value $x$:

$$D_{i}^{n+1} = D_{i}^{n} \cdot d_{i}(x)$$

$$d_{i}(x) = \begin{cases} 
0, & x > x_{\text{max}} \cup x < x_{\text{min}} \\
\exp \left[ -\frac{1}{2} \left( \frac{x - x_{\text{med}}}{x_{\text{desv}}} \right)^2 \right], & \text{otherwise}
\end{cases}$$

Empirical equations inspired by Bayes rule and gaussian distribution.

Minimum, Maximum, Median & Deviation are computed from real samples and manually revised.
OBJECT RECOGNITION

Human correction of non recognized objects
CONCLUSIONS

LitterDrone

The image shows a concluding slide titled "CONCLUSIONS" with a drawing of a drone labeled "LitterDrone." The slide contains a photograph of a person flying a drone. The background includes a map with various countries and an "esa" logo on the right side.
CONCLUSIONS

- Interesting project ending at January 2019.

- Future Lines:
  - Testing New Cameras.
  - Improving Object Recognition.
  - Jump to Market.

MEETING OF DRONE TECHNOLOGY, REMOTE SENSING AND COMPUTER VISION,
MORE PROJECTS OF THIS KIND ARE EXPECTED IN THE FUTURE
RECOMMENDATIONS

- Pay attention to drone technology & computer vision.

- Drone technology & hyperspectral sensors (or new hyperspectral sensors for drones).

- Drone imaging over the sea (near to coastline and/or drones launched from ships).

- Projects trying to integrate drone and satellite images.
THANK YOU!

LITTERDRONE PROJECT

The LitterDrone project seeks to develop innovative tools for the control and management of marine litter through unmanned drones.

www.litterdrone.eu