DEEL

DEpendable & Explainable Learning

IVADO

IRT SAINT EXUPÉRY

CRIAQ
Consortium de recherche et d'innovation en aérospatiale au Québec

ANITI
Porté par l'Université de Toulouse

Institut intelligence et données

Regression toy-case (binary loss)

Regression model:

$$Y = \frac{X+1}{3} + \frac{|\sin(3\pi X)|}{3}\,\epsilon$$

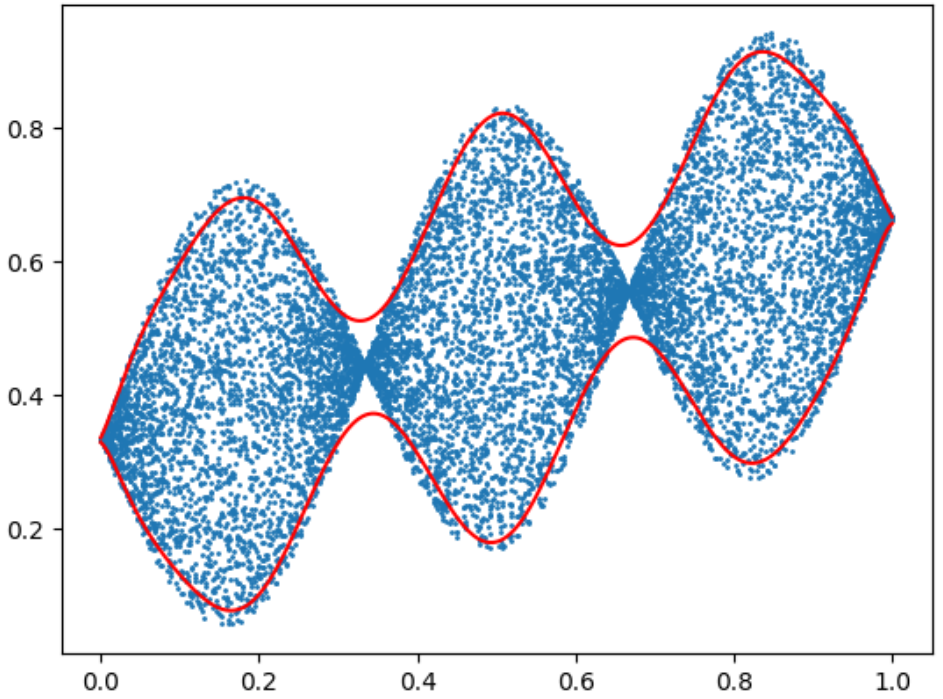
with $X \sim U([0,1]) \perp \epsilon \sim U([-1,1])$

Loss function: $L(y,S) = 1_{y \notin S}$

Prediction sets:

$$C_\lambda(x) = [\,\hat{q}_{5\%}(x) - \lambda,\ \hat{q}_{95\%}(x) + \lambda]$$

$\hat{q}_{5\%}$ and $\hat{q}_{95\%}$ are trained on some independent dataset



Application of RCPS

Calibration data: $n = 10^4$ independent copies of (X, Y)

We apply RCPS with the target miscoverage $\alpha = 0.05$ and the risk level $\delta = 10^{-9}$

The initial prediction set (with $\lambda = 0$) was undercovering. RCPS inflates it by selecting:

$$\hat{\lambda}_n \approx 0.016$$

On an independent test set of 10^4 points, we observe a miscoverage of 0.0409 (consistent with the guarantee).

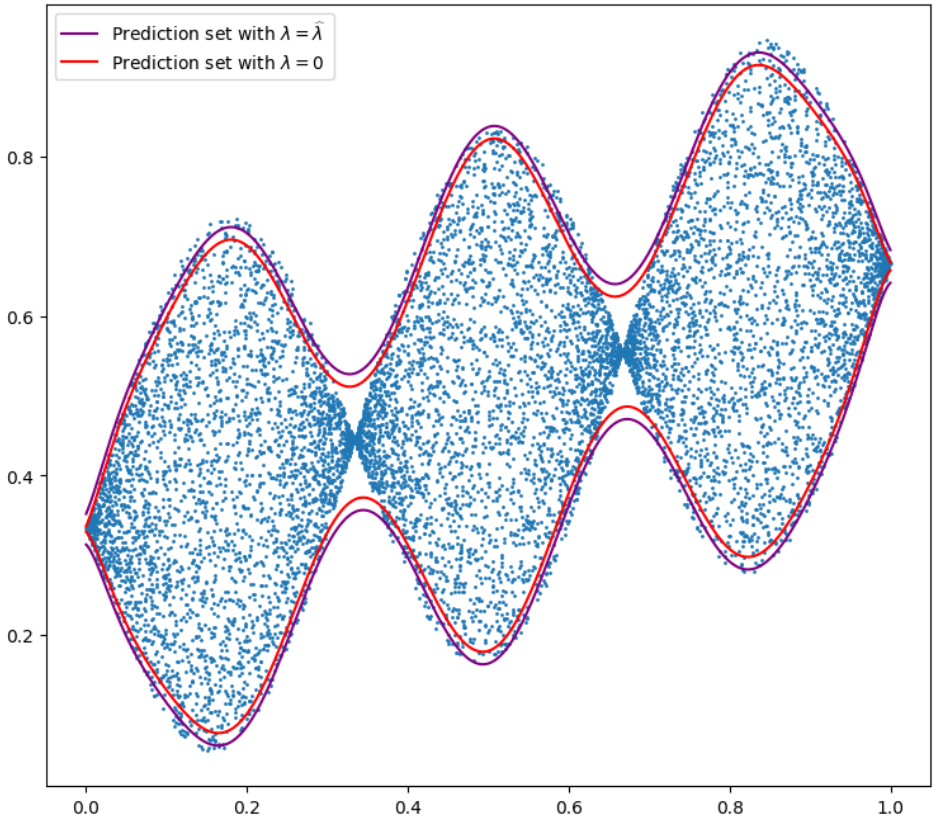


Figure: Prediction sets before and after calibration (plot on test set)

Regression toy-case (non-binary loss)

Same regression model:

$$Y = \frac{X+1}{3} + \frac{|\sin(3\pi X)|}{3}\,\epsilon$$

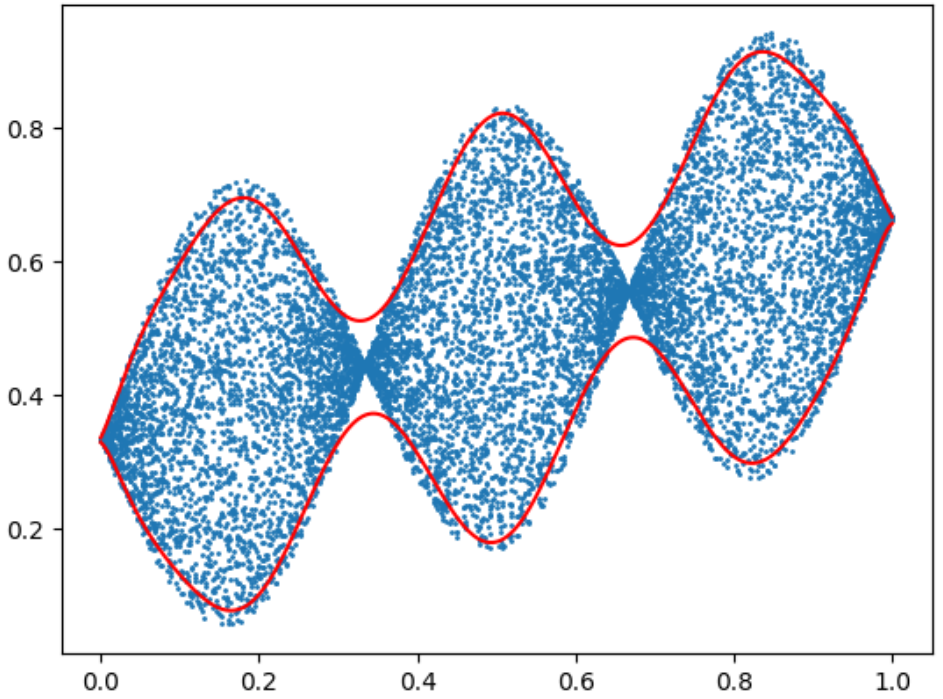
with $X \sim U([0,1]) \perp \epsilon \sim U([-1,1])$

Other loss function: $L(y,S) = dist(y,S)$

Prediction sets:

$$C_\lambda(x) = [\,\hat{q}_{5\%}(x) - \lambda,\ \hat{q}_{95\%}(x) + \lambda]$$

$\hat{q}_{5\%}$ and $\hat{q}_{95\%}$ are trained on some independent dataset



Application of RCPS

Calibration data: $n = 10^6$ independent copies of (X, Y)

We apply RCPS with the target average distance $\alpha = 10^{-4}$ and the risk level $\delta = 10^{-9}$

The initial prediction set (with $\lambda = 0$) was undercovering. RCPS inflates it by selecting:

$$\hat{\lambda}_n \approx 0.026$$

On an independent test set of 10^6 points, we observe an average distance of $\approx 10^{-4} = \alpha$ as desired.

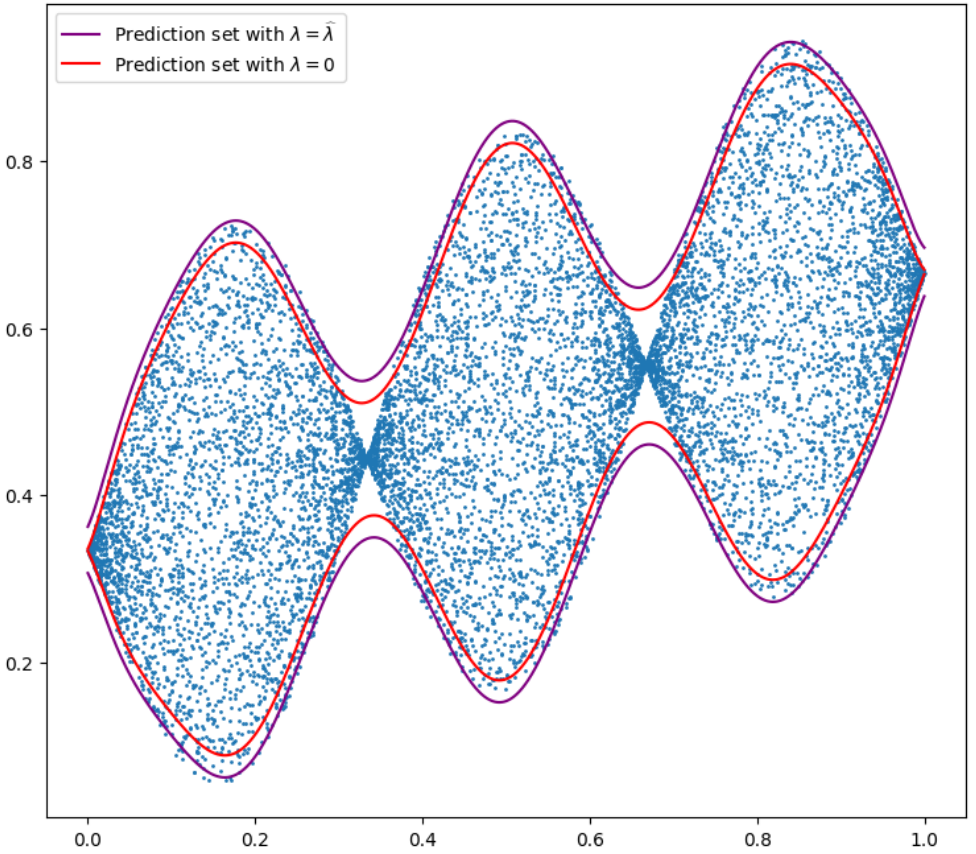
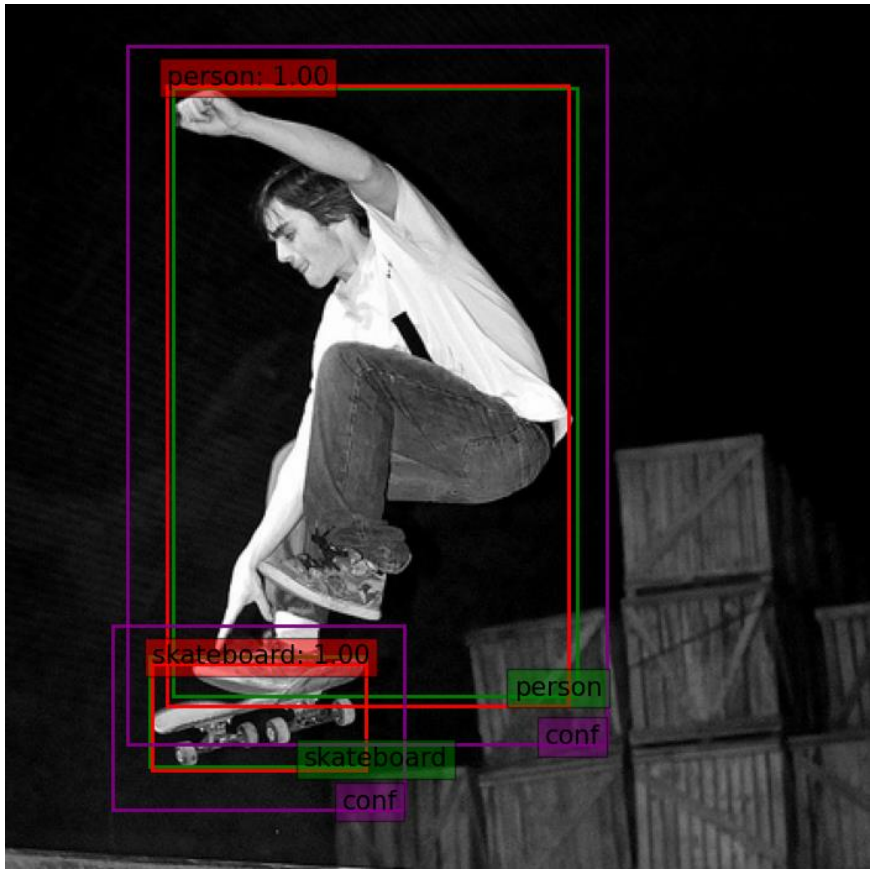


Figure: Prediction sets before and after calibration (plot on test subset)

Object detection on MS COCO

- **Multiple tasks:** localization (4d multivariate regression) + classification (80 classes):
  - Calibration: 2500 examples
  - Test: 2500 examples
- **Predictor:** DETR (Carion, 2020)
- **Loss function:**
  - Classification: Binary
  - Localization: Binary or Pixel Recall
- **Prediction Set:**
  - Classification: λ-thresholded softmax
  - Localization: additive or multiplicative margins
  - Cartesian product with threshold on confidence



PhD work (Andéol et al. 2023, soon on arXiv)

The DEEL software suite

DEEL
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XPLIQUE

Explainability Toolbox for Neural Networks

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INFLUENCIAE

A Tensorflow Toolbox for Influence Functions

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OODEEL

A post-hoc deep OOD detection toolbox

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DEELIP

LIPSCHITZ KERAS LAYERS

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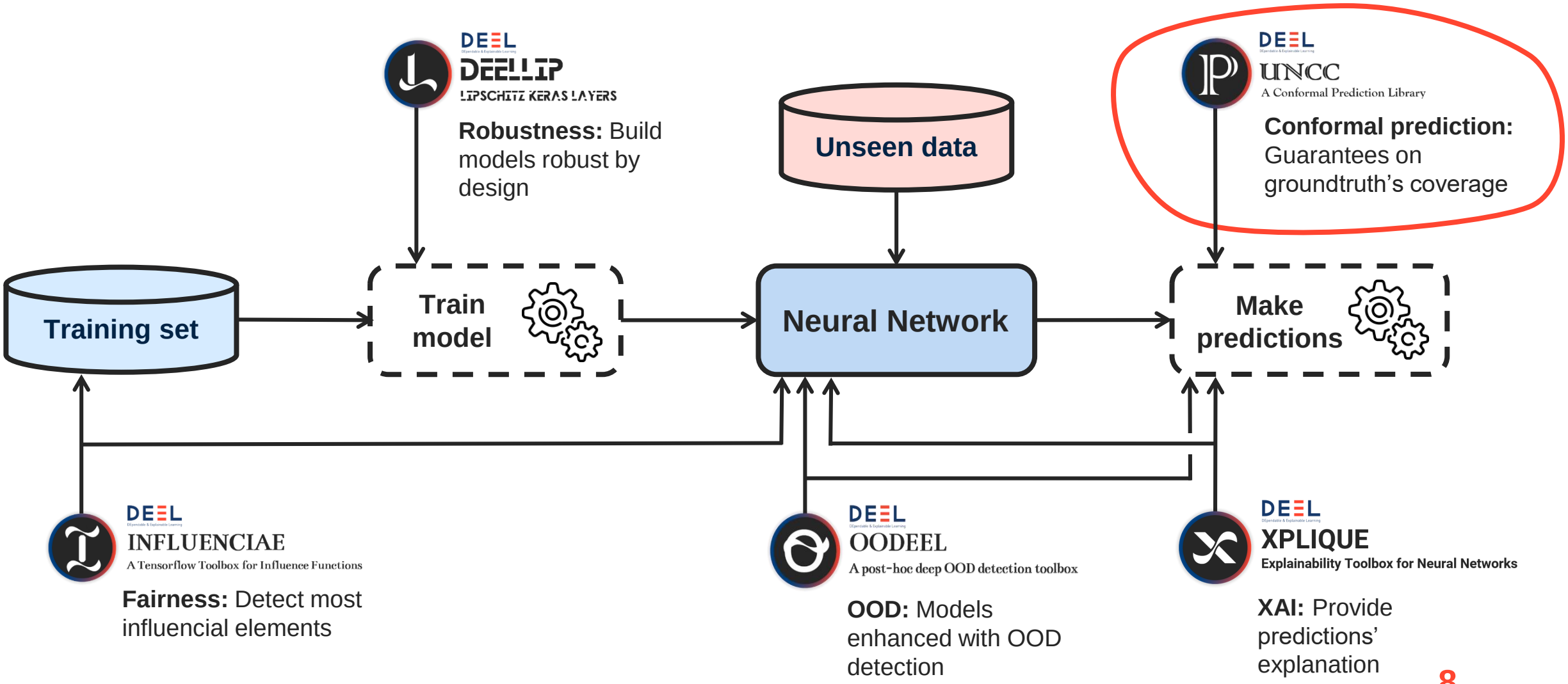
UNCC

A Conformal Prediction Library

- Python libraries available on GitHub
- User-friendly APIs, easy to use, examples and tutorials
- State-of-the-art methods, up-to-date with the latest research publications
- Ongoing maintenance by the DEEL team. Contributors are welcome

Credits (next slides): Joseba Dalmau, Thierry Daubos, Corentin Friedrich, Agustin Martin Picard, Mouhcine Mendil, Luca Mossina, Vincent Mussot, Paul Novello, Yannick Prudent

The Big Picture



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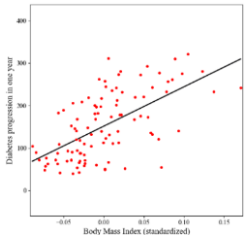
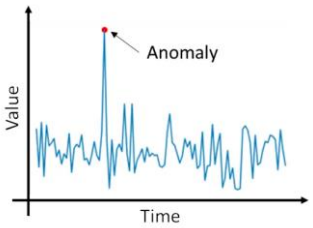
Support for diverse Machine learning tasks

Classification

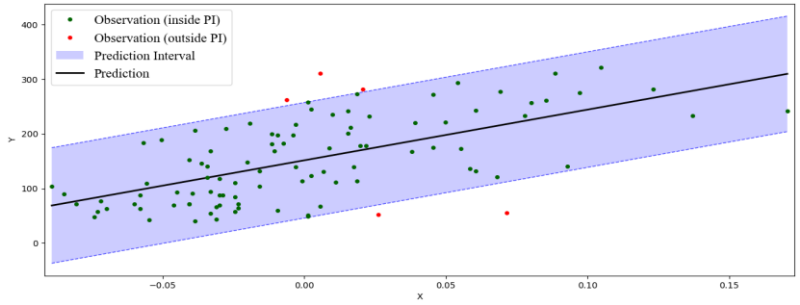
Regression



Anomaly Detection

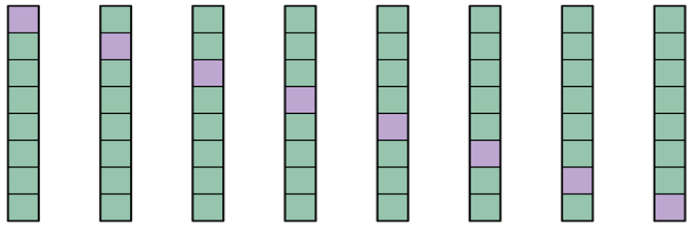


Error metrics and plotting functions



SOTA conformal prediction and data-splitting methods

- Split-Conformal
- Jackknife+
- Cross-validation+



Ongoing development

- Update with most recent methods
- Online conformal prediction
- Integration of new tasks (multivariate regression, etc.)

github.com/deel-ai/puncc

LARD: Dataset for Runway Detection

- **18K images**
  From ~**200** different runways
- Videos of **real landing footage**
  1800 frames from **200** videos manually annotated
- **A scenario generator** for trajectories in Google Earth
- **Automatic labeling** of images
- Github and details:
  https://github.com/deel-ai/LARD
  https://arxiv.org/abs/2304.09938

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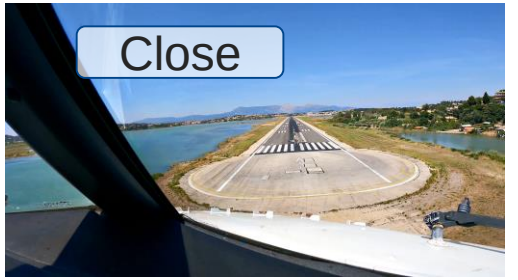
ONERA THE FRENCH AEROSPACE LAB

AIRBUS

15K Synthetic images (training)

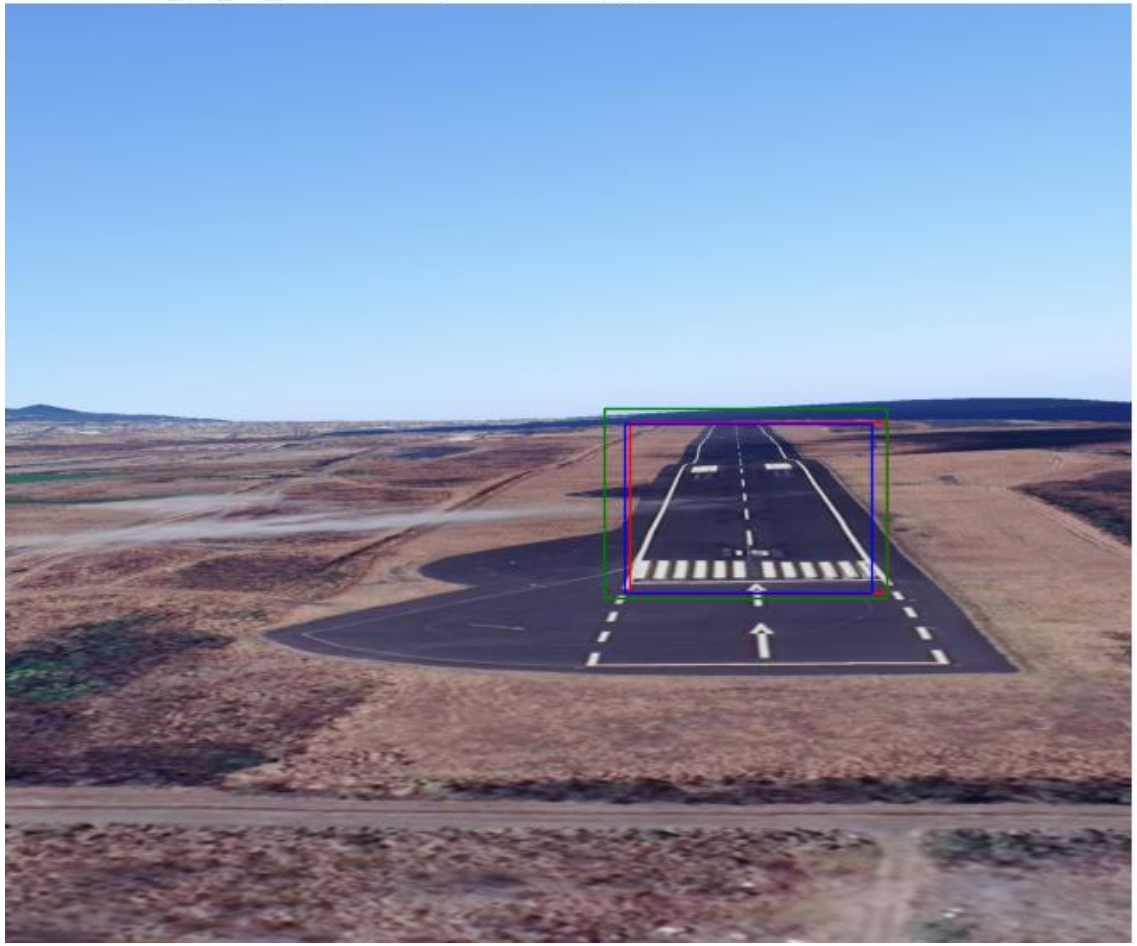
1 800 Real images (test)



LARD in action

Applying PUNCC: ex with split CP (α=0.1)

FMEP_15_35_27, red: GT, blue: pred, green: conformal

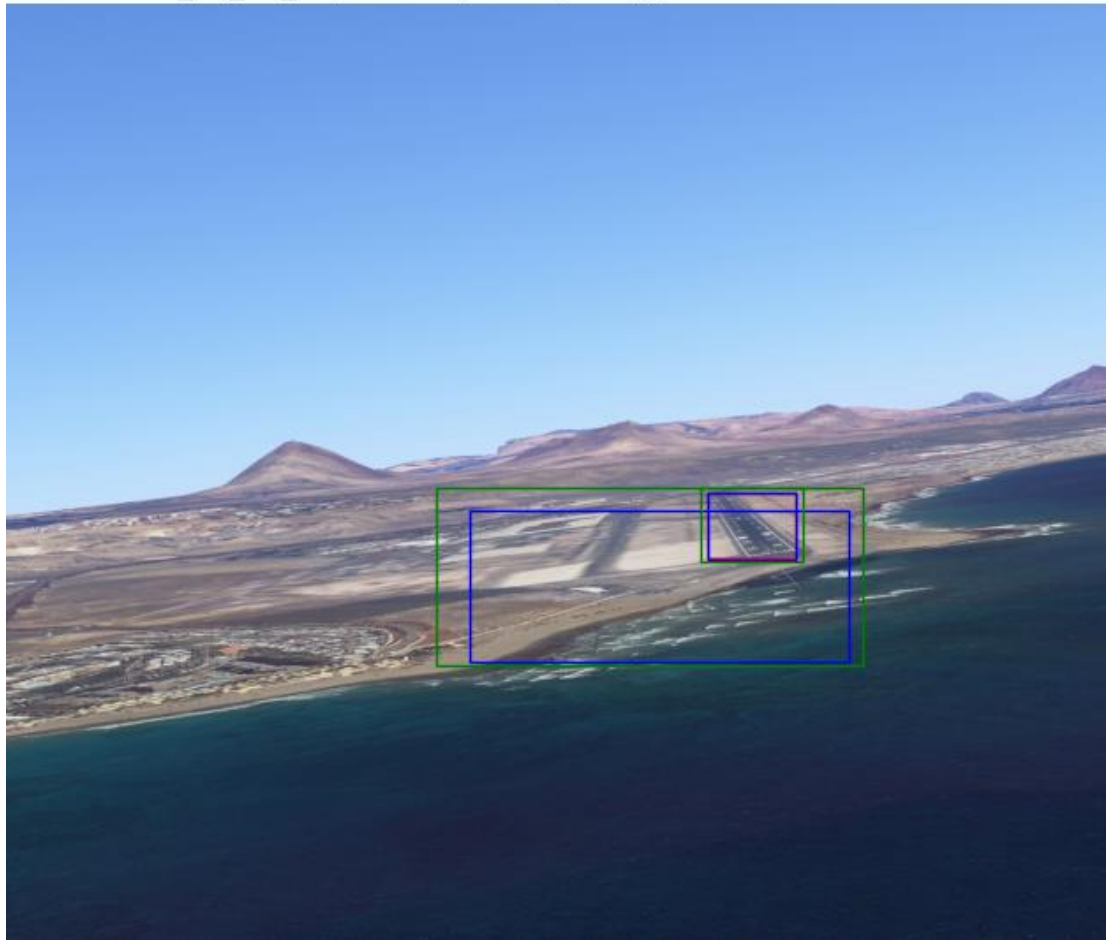


RPMD_23_35_19, red: GT, blue: pred, green: conformal

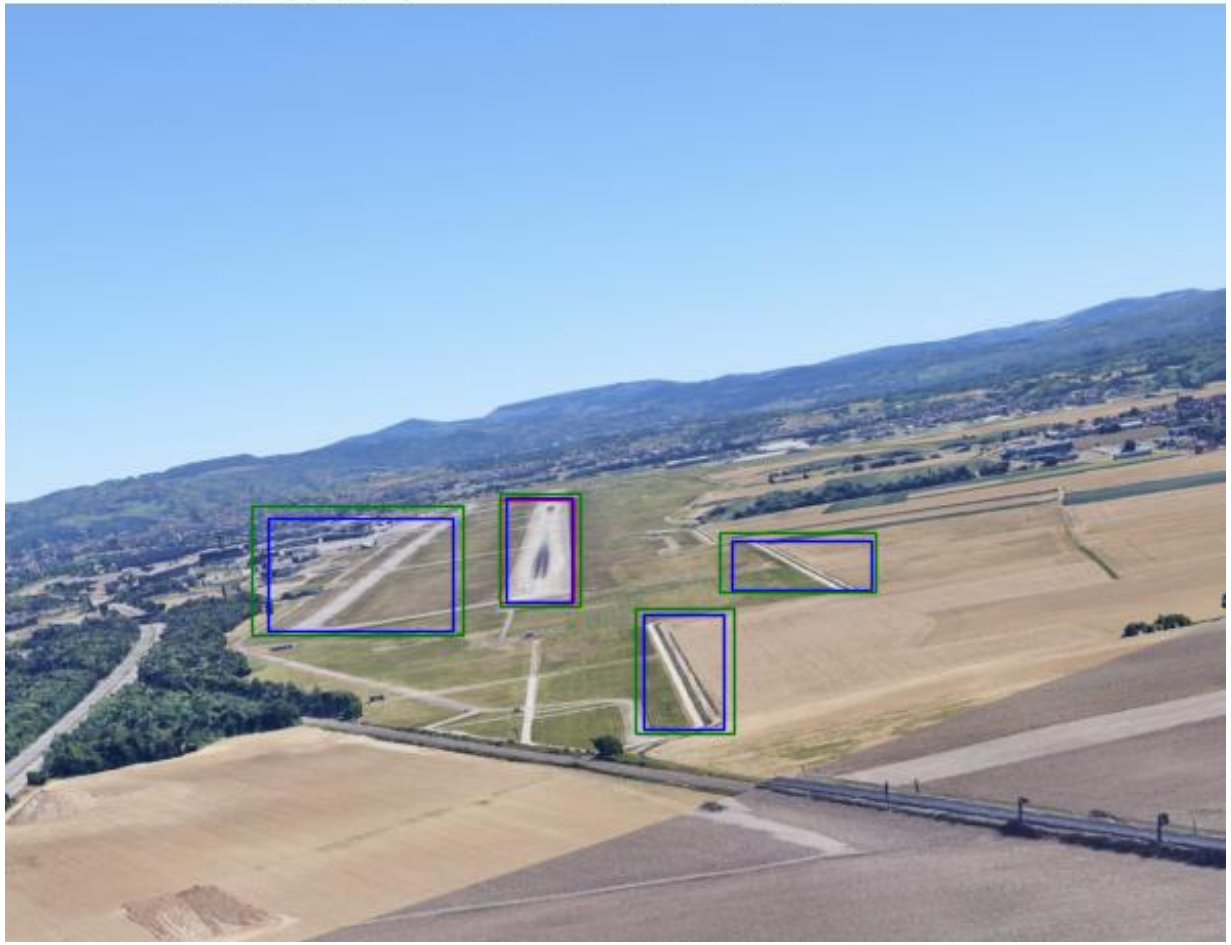
Classic FCOS - Synthetic test set

Similar examples

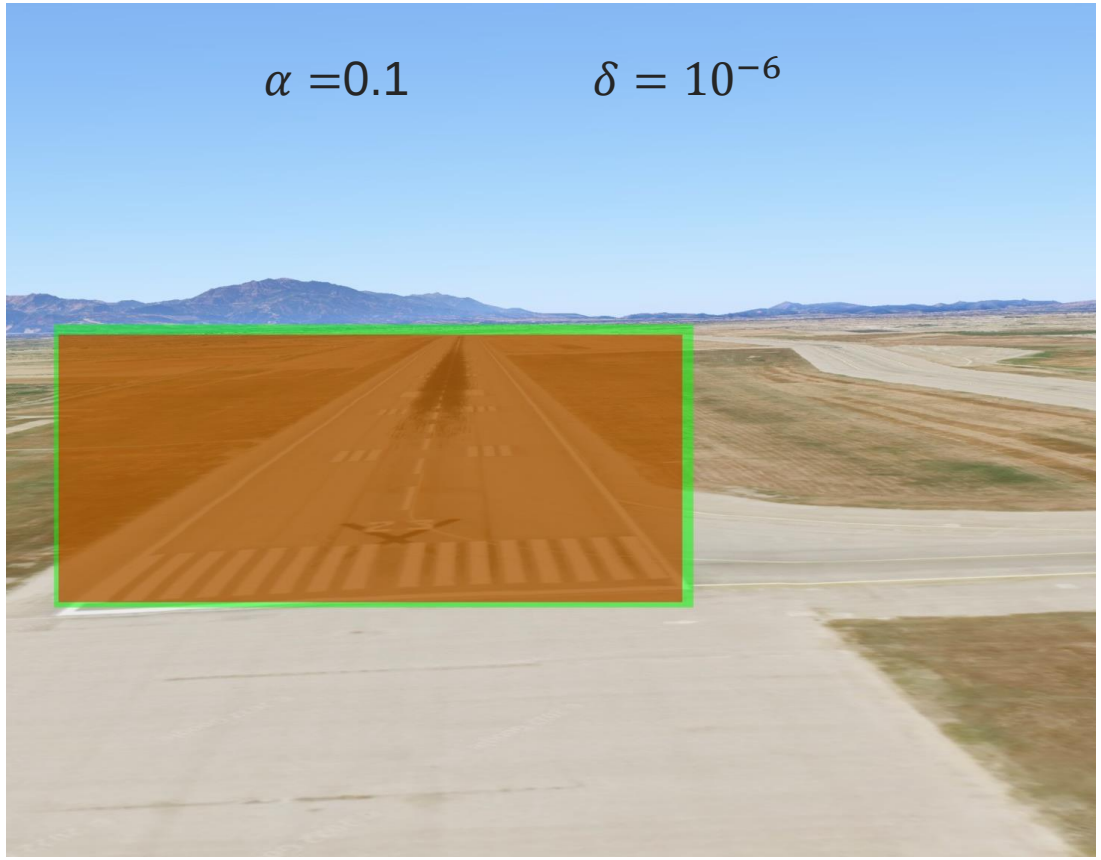
GCRR_03_35_15, red: GT, blue: pred, green: conformal

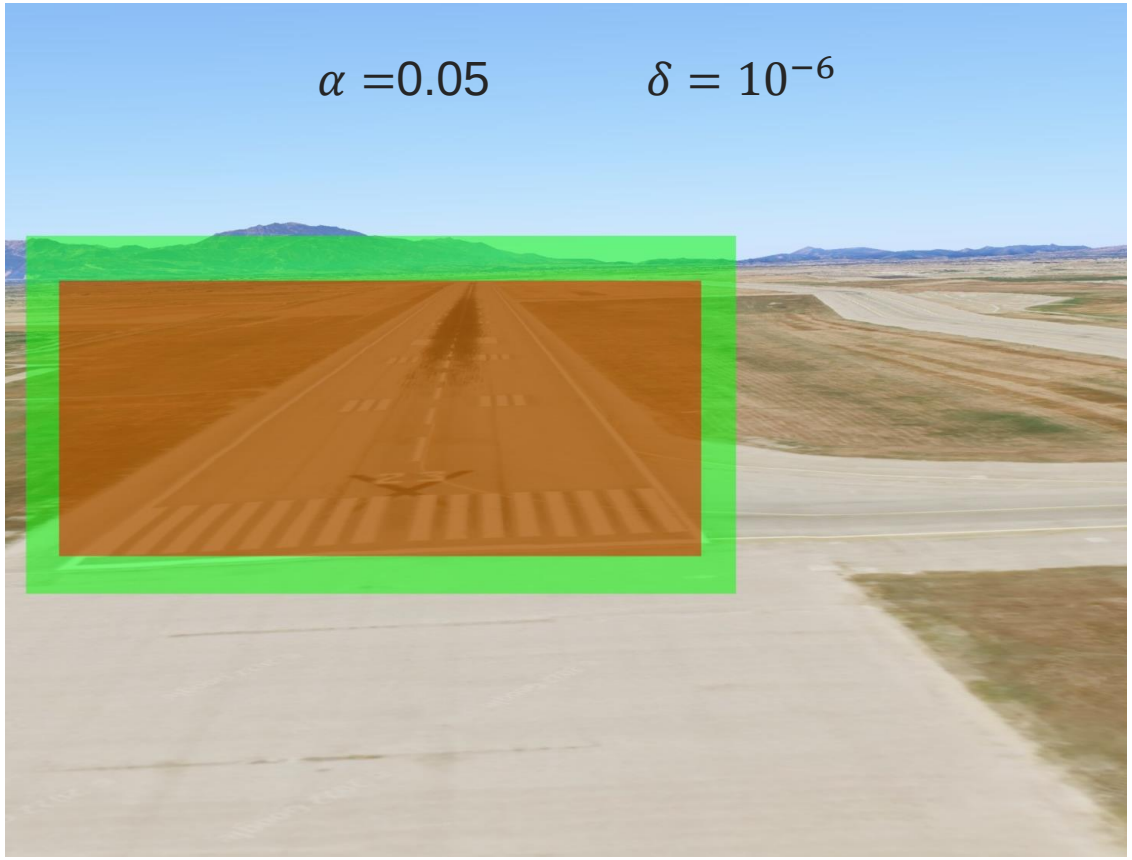


LFSB_15_35_14, red: GT, blue: pred, green: conformal



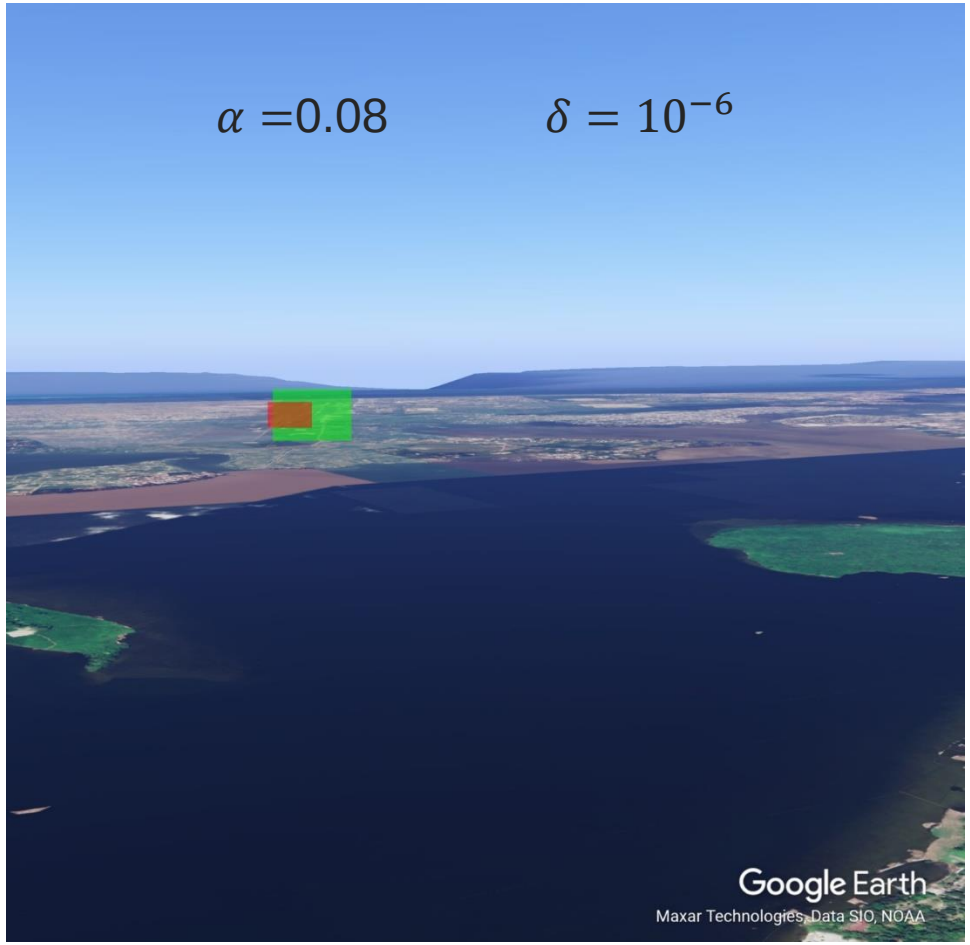
Examples with RCPS (binary loss)

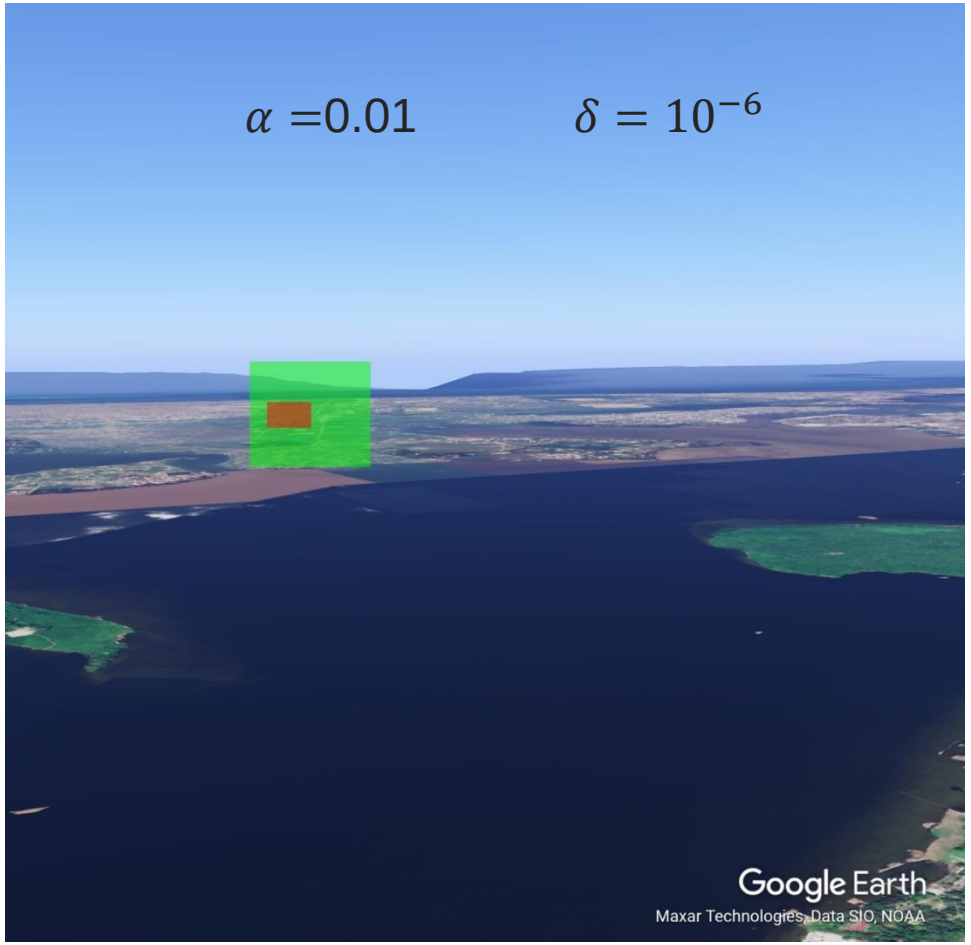




Yolo v5 - Synthetic test set (in green: conformalized boxes)

Similar examples





Yolo v5 - Synthetic test set (in green: conformalized boxes)

Want to know more ?

www.deel.ai

github/deel-ai

linkedin/showcase/deel-ai

Want to join DEEL ?

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Thank you for your attention

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