Year 10 – Project Update

- **Project 10a.002.TAU-WP6 - Operational Support Estimator Network (OSEN) for Sparse Support Estimation and learning-aided Compressive Sensing**

Project Team

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Project Goals & Novelty of Approach

- An approach for energy efficient Support Estimation (SE) and learning-aided Compressive Sensing (CS).
- For an efficient and non-iterative SE, we propose Operational Support Estimator Networks (OSENs). The proposed OSEN consists of operational layers that highly improve the learning capability of the network by the introduced non-linearity.
- Moreover, the proposed OSEN has a unique strategy to highly enhance the classification performance. The network uses hybrid-loss that penalizes both SE estimation and classification errors during the training.
- This project builds the first step of solving linear inverse problems using networks with non-linear neuron models.

Benefits to IAB

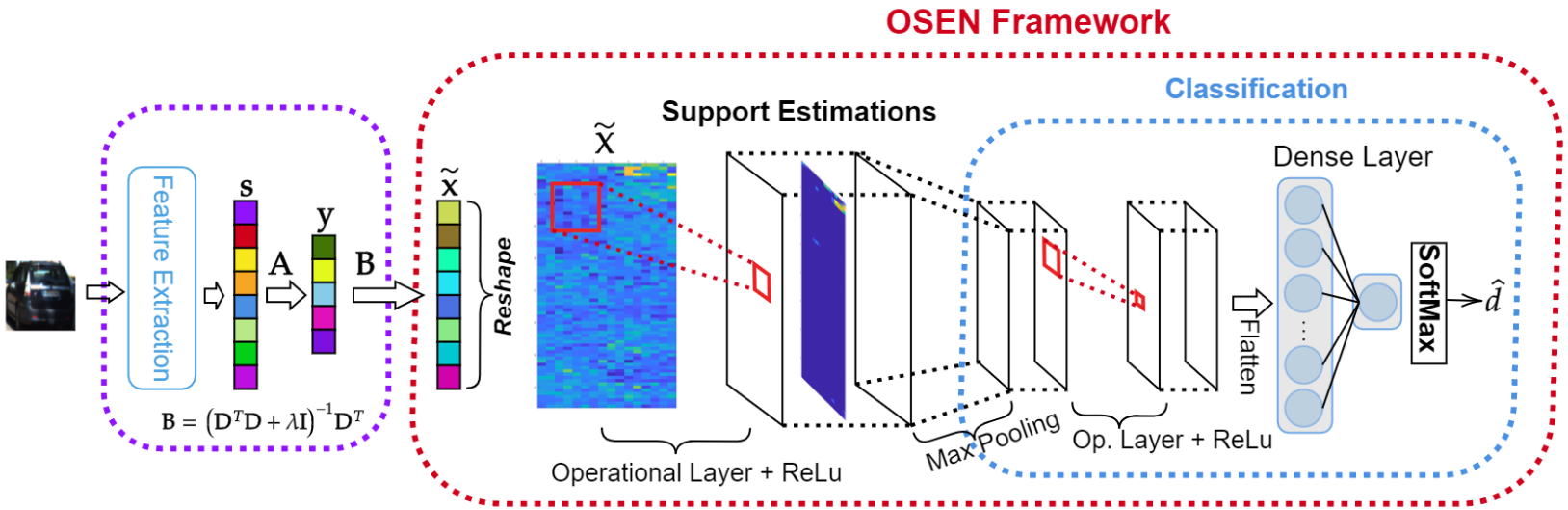
- Advanced Machine Learning especially for scarce data is a great asset for any service company offering AI solutions to real world problems.

- The proposed approach can be used in many tasks such as classification, anomaly localization, and various CS based applications including compressive video surveillance systems and Distributed Compressive Sensing based surveillance.

- A hybrid method: the output of OSEN also provides the probability of support sets that will be used as *prior* in the classical CS schemes. In this way, the newly introduced learning-aided CS scheme with OSENs addresses the time complexity issue of the recovery algorithms.

Project Accomplishments

- Implementation of the baseline approaches and competing methods.
- Implementation of the non-iterative support estimator using the proposed OSEN approach.
- Designing the OSEN framework for the representation-based classification task.



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Research Results

- CSEN and OSEN:
  # of dictionary samples: $32 \times 38 = 1216$ samples.
  # of train samples: $16 \times 38 = 608$ samples.
  # of test samples: $16 \times 38 = 608$ samples.

- Other methods:
  # of dictionary samples: $48 \times 38 = 1824$ samples.
  # of test samples: $16 \times 38 = 608$ samples.

- Network structure
  CSEN1: [In - 96 - 96 - Out]
  CSEN2: [In - 64 - 64 - 64 - Out]
  OSEN: [In - 64 - 64 - Out]
  with 5×5 filters.

Face recognition accuracies over Yale-B dataset using different m/d, Compression Rate (CRs).

CR	CRC	DALM	ADMM	CSEN1	CSEN2	OSEN (q=1)	OSEN (q=2)	OSEN (q=3)	OSEN (q=4)	OSEN (q=5)
0.01	0.1797	0.4356	0.2576	0.5559	0.5288	0.5017	0.5695	0.5797	0.5898	0.5458
0.025	0.7136	0.8492	0.8661	0.8254	0.8322	0.8017	0.8610	0.8610	0.8542	0.8203
0.05	0.9000	0.9390	0.9475	0.8475	0.8797	0.8407	0.9051	0.9000	0.8864	0.8746
0.1	0.9542	0.9593	0.9627	0.8356	0.8475	0.7814	0.8949	0.8644	0.8881	0.8695

Next Steps/Deliverables & Timeline

Deliverables/Steps	Start Date	Completion Date
Implementation of the non-iterative support estimator using the proposed OSEN approach.	September 2021	Completed
Building a representation-based classification framework with the proposed support estimator.	November 2021	March 2022
Improved classification framework with the hybrid loss penalizing both SE estimation and classification errors during the training.	April 2022	May 2022
Learning-aided CS scheme with the prior information produced by the OSEN.	June 2022	Sept 2022

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Questions?