Research Papers:

These are some research papers that we read and tried to implement in our model:

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1. SAR-to-Optical Image Translation Using Supervised Cycle Consistent Adversarial Networks

Summary:

This paper proposes a novel approach to translating SAR (Synthetic Aperture Radar) images into optical (EO) images by combining **supervised learning** with the **CycleGAN framework**. Traditional CycleGAN is fully unsupervised and focuses only on cycle-consistency and adversarial losses. However, this method leverages paired SAR-EO data to introduce a **direct L1 loss** between the generated EO image and its ground truth, enhancing pixel-level accuracy.

Key Contributions:

- **Supervised L1 Loss**: Encourages generated images to be closer to ground truth when paired data is available.
- **Cycle-Consistency**: Ensures that mappings in both directions (SAR→EO and EO→SAR) are meaningful and consistent.
- **Adversarial Training**: Uses PatchGAN to generate realistic-looking EO images.
- **Improved Details**: Results show better texture, structure, and spectral fidelity than standard CycleGAN.

What We Used in Our Project:

- **CycleGAN backbone** with dual generators and discriminators.
- **L1 Supervised Loss** between generated EO and ground truth EO when paired data is available.
- **Cycle-Consistency Loss** to ensure stability and regularization in translation.
- We **did not use semantic segmentation supervision**, as our dataset lacks pixel-level semantic labels.

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2. Seg-CycleGAN: SAR-to-Optical Translation Guided by a Downstream Task

Summary:

Seg-CycleGAN enhances SAR-to-EO translation by integrating **semantic awareness** using a downstream segmentation task. The authors propose guiding the generator with a **pretrained EO segmenter**, which encourages the translated images to retain meaningful class-level structures (like roads, buildings, vegetation).

Key Contributions:

- **EO Segmenter**: Pretrained on real EO images to segment classes like water, land, etc.
- **Semantic Consistency Loss**: Ensures that generated EO images maintain class structure, as evaluated by the segmenter.
- **Better Generalization**: Especially useful in remote sensing tasks where semantic accuracy is crucial (e.g., land cover mapping).

- **No Need for SAR Labels**: The segmentation guidance only needs EO labels, not

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What We Used in Our Project:

- We **did not include a segmentation-guided loss** in our implementation.
- No use of a **pretrained EO segmenter** to guide translation.
- However, we studied this method to understand the benefit of **semantic guidance** and may explore it in future work if labels or pretrained segmenters are available.
