Semi-supervised semantic segmentation using alignment and uniformity

Next-gen AI segmentation model offering efficient, accurate perception for vehicles, health, and satellites.

Researchers at Purdue University have developed a novel model for semi-supervised semantic segmentation called SWSEG. Semantic segmentation, the task of assigning pixel-level labels to images, is a cornerstone in domains such as autonomous driving and medical image analysis. While most current learning methods struggle to adequately maintain standards of alignment and uniformity, SWSEG is able to optimize these areas using an innovative algorithm while also leveraging established knowledge in the field. SWSEG surpasses existing state-of-the-art training methods in not only alignment and uniformity, but also training efficiency, marking it as the next step forward in the field of AI-image training, which will be essential for the emerging fields of autonomous automotives, smart health imaging, next-gen satellite imaging, and more.

Technology Validation:

SWSEG was evaluated on the PASCAL VOC 2012, Cityscapes, and ADE20K datasets, where it outshone supervised baselines in mIoU by up to 11.8%, 8.9%, and 8.2%, respectively, given an equivalent number of labeled samples. Further, SWSEG was found to surpass state-of-the-art methods in multiple settings across these three datasets. The extensive ablation studies confirm the optimization of the uniformity and alignment objectives of the feature representations.

Advantages:

-Improved feature alignment and uniformity

-Energy-efficient and label-efficient

-Real-time perception

-Improved training efficiency

Technology ID

2025-CHAT-71116

Category

Artificial Intelligence & Machine Learning/Computer Vision & Image Recognition
Aerospace & Defense/Autonomous Systems (UAVs & AVs)

Authors

Somali Chaterji
Chen-Yi Lu

Further information

Matt Halladay
MRHalladay@prf.org

View online

Applications:

-Industries in which real-time, energy-efficient, and label-efficient perception systems are needed, such as:

-Autonomous vehicles

-Robotics

-Satellite imaging

-Artificial intelligence

-Health imaging and diagnostics

-Remote sensing

Publications:

https://cvpr.thecvf.com/virtual/2025/poster/32438

TRL: 4

Intellectual Property:

Provisional-Patent, 2025-04-11, United States

Keywords: Semi-supervised semantic segmentation,AI image labeling,Feature alignment optimization,Real-time computer vision,Energy-efficient AI training,Label-efficient machine learning,Autonomous vehicle perception,Medical image analysis AI,Satellite image processing,Robotics vision systems,Remote sensing analytics,Advanced AI model training,Uniformity in feature learning,Efficient AI segmentation