Semantic segmentation is a computer vision problem, where each pixel of an input image is assigned a label corresponding to a class or type of object it belongs to. This technique can be applied in many applications, where understanding the type, shape, occlusion, orientation, or position of an object of interest is important.

Determining information from satellite imagery in an automated way presents a unique challenge. Overhead images have less detailed features with lower spatial resolution. The environment can introduce occlusions by clouds and variation from seasons or weather. To ameliorate these issues, satellites capture additional image channels through a wider band of the electromagnetic spectrum. In contrast, a conventional camera captures three image channels: red, green, and blue.

SpaceNet® (1) provides tools, datasets, and challenges to promote research on machine learning for satellite imagery. We used the Las Vegas Area of Interest 2 dataset consisting of imagery collected by DigitalGlobe™ WorldView-3 with eight multispectral bands.

For semantic segmentation, we trained a deep convolutional neural network based on the U-net topology (2). U-net begins with an encoder phase, where convolution and pooling layers reduce the input image, to an encoded representation that is spatially smaller, but greater in depth. This encoded representation is then used by a decoder phase, where convolution and deconvolution layers expand the encoded representation into a multidimensional array of segmentation probabilities. A segmentation mask output with the same size as the input image, gives an identifier of the class of highest probability per pixel.

Deep learning inference was implemented and accelerated using the Intel® Distribution of OpenVINO™ toolkit. First the Model Optimizer software is used to optimize and convert a deep learning model from popular training frameworks to an intermediate representation. This intermediate representation can be used by Inference Engine to deploy the model across various Intel hardware options for deep learning inference. Here we chose to deploy the model for acceleration by the Intel® Arria® 10 GX FPGA.

**References**


© Intel Corporation. All rights reserved. Intel, the Intel logo, the Intel Inside mark and logo, Altera, Arria, Cyclone, Eptirion, Experience What’s Inside, Intel Atom, Intel Core, Intel Xeon, MAX, Nios, Quartus, and Stratix words and logos are trademarks of Intel Corporation or its subsidiaries in the U.S. and/or other countries. Intel reserves the right to make changes to any products and services at any time without notice. Intel assumes no responsibility or liability arising out of the application or use of any information, product, or service described herein except as expressly agreed to in writing by Intel. Intel customers are advised to obtain the latest version of device specifications before relying on any published information and before placing orders for products or services. * Other marks and brands may be claimed as the property of others.

Aug 2019 Intel