**Table A1.** Downsampling Block Details

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Downsampling Block** | **Input** | **Output** | **Type** | **Kernel** | **Stride** | **Padding** |
| Encoder1 | 1024x1024x3 | 1024x1024x64 | Double Conv+Resnet | 3x3 | 1 | 1 |
| 1024x1024x64 | 512x512x64 | Max pooling | 2x2 | 2 | 0 |
| Encoder2 | 512x512x64 | 512x512x128 | Double Conv+Resnet | 3x3 | 1 | 1 |
| 512x512x128 | 256x256x128 | Max pooling | 2x2 | 2 | 0 |
| Encoder3 | 256x256x128 | 256x256x256 | Double Conv+Resnet | 3x3 | 1 | 1 |
| 256x256x256 | 128x128x256 | Max pooling | 2x2 | 2 | 0 |
| Encoder4 | 128x128x256 | 128x128x512 | Double Conv+Resnet | 3x3 | 1 | 1 |
| 128x128x512 | 64x64x512 | Max pooling | 2x2 | 2 | 0 |

**Table A2.** MSF Block Details

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **MSF Branch** | **Input** | **Output** | **Type** | **Dilation Rate** | **Kernel** | **Stride** | **Padding** |
| Branch0 | 64x64x512 | 64x64x512 | Dilated Conv | 1 | 3x3 | 1 | 1 |
| Branch1 | 64x64x512 | 64x64x512 | Dilated Conv | 2 | 3x3 | 1 | 2 |
| Branch2 | 64x64x512 | 64x64x512 | Dilated Conv | 2 | 3x3 | 1 | 2 |
| Branch3 | 64x64x512 | 64x64x512 | Dilated Conv | 1 | 3x3 | 1 | 1 |
| Connect | 64x64x2048 | 64x64x1024 | Conv | - | 1x1 | 1 | 0 |

**Table A3.** Upsampling Block Details

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Upsampling Block** | **Input** | **Output** | **Type** | **Kernel** | **Stride** | **Padding** |
| Decoder1 | 64x64x1024 | 128x128x512 | Up Sampling | 2x2 | 2 | 0 |
| 128x128x512 | 128x128x1024 | Skip connection  (Encoder4) | - | - | - |
| 128x128x1024 | 128x128x512 | Double Conv+CoA | 3x3 | 1 | 1 |
| Decoder2 | 128x128x512 | 256x256x256 | Up Sampling | 2x2 | 2 | 0 |
| 256x256x256 | 256x256x512 | Skip connection  (Encoder3) | - | - | - |
| 256x256x512 | 256x256x256 | Double Conv+CoA | 3x3 | 1 | 1 |
| Decoder3 | 256x256x256 | 512x512x128 | Up Sampling | 2x2 | 2 | 0 |
| 512x512x128 | 512x512x256 | Skip connection  (Encoder2) | - | - | - |
| 512x512x256 | 512x512x128 | Double Conv+CoA | 3x3 | 1 | 1 |
| Decoder4 | 512x512x128 | 1024x1024x64 | Up Sampling | 2x2 | 2 | 0 |
| 1024x1024x64 | 1024x1024x128 | Skip connection  (Encoder1) | - | - | - |
| 1024x1024x128 | 1024x1024x64 | Double Conv+CoA | 3x3 | 1 | 1 |
| 1024x1024x64 | 1024x1024x1 | Conv | 1x1 | 1 | 0 |

**Table A4.** Comparative experimental model

|  |  |  |
| --- | --- | --- |
| **No.** | **Model** | **Description** |
| 1 | U-Net | Encoder-decoder architecture |
| 2 | FCN | Fully Convolutional Network |
| 3 | SegNet | Encoder-decoder architecture |
| 4 | Deeplab V3+ | Dilated convolution and encoder-decoder architecture |
| 4 | R-Net | U-Net with ResNet added to the downsampling |
| 5 | RC-Net | U-Net with ResNet added to the downsampling and CoA to the upsampling |

**Table A5.** RC-MSFNet Model's Different Parameter Rural Road Extraction Results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **No.** | **Parameter Settings** | | ***P*** | **F1** | **IOU** | **COM** |
| *A* | MSF(*d*1=1.2.4.8) | CoA(*r*2=4) | **0.8464**3 | 0.7801 | 0.6395 | 0.7234 |
| MSF(*d*=1.2.4.8) | CoA(*r*=8) | 0.8462 | 0.7799 | 0.6392 | 0.7233 |
| MSF(*d*=1.2.4.8) | CoA(*r*=16) | 0.8247 | 0.7807 | 0.6403 | 0.7412 |
| MSF(*d*=1.2.4.8) | CoA(*r*=32) | 0.8193 | 0.7699 | 0.6258 | 0.7261 |
| *B* | MSF(*d*=1.4.8.12) | CoA(*r*=4) | 0.8212 | 0.7771 | 0.6354 | 0.7374 |
| MSF(*d*=1.4.8.12) | CoA(*r*=8) | 0.8336 | 0.7670 | 0.6220 | 0.7102 |
| MSF(*d*=1.4.8.12) | CoA(*r*=16) | 0.8311 | 0.7712 | 0.6276 | 0.7193 |
| MSF(*d*=1.4.8.12) | CoA(*r*=32) | 0.8119 | 0.7820 | 0.6421 | 0.7442 |
| *C* | MSF(*d*=1.2.2.1) | CoA(*r*=4) | 0.8263 | 0.7710 | 0.6273 | 0.7227 |
| MSF(*d*=1.2.2.1) | CoA(*r*=8) | 0.8458 | 0.7800 | 0.6393 | 0.7177 |
| MSF(*d*=1.2.2.1) | CoA(*r*=16) | 0.8214 | 0.7662 | 0.6210 | 0.7179 |
| MSF(*d*=1.2.2.1) | CoA(*r*=32) | 0.8350 | **0.7896** | **0.6523** | **0.7489** |

1 Refers to the dilation rates at different scales in MSF. 2 Denotes the reduction factor for the number of channels in CoA. 3 Bold text indicates optimal values for each column.

**Table A6.** Different Models' Rural Road Extraction Results on the XARoads Dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | ***P*** | **F1** | **IOU** | **COM** |
| U-Net | 0.7970 | 0.7414 | 0.5890 | 0.6930 |
| FCN | 0.7672 | 0.6833 | 0.5190 | 0.6160 |
| SegNet | 0.7565 | 0.6820 | 0.5174 | 0.6209 |
| DeeplabV3+ | 0.8136 | 0.6981 | 0.5362 | 0.6114 |
| R-Net | 0.8292 | 0.7592 | 0.6119 | 0.7001 |
| RC-Net | 0.8097 | 0.7645 | 0.6188 | 0.7241 |
| RC-MSFNet | **0.8350**1 | **0.7896** | **0.6523** | **0.7489** |

1 Bold text indicates the optimal values for each column.

**Table A7.** Different Models' Rural Road Extraction Results on the DeepGlobe Dataset

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Model** | ***P*** | **F1** | **IOU** | **COM** |
| U-Net | 0.7979 | 0.7658 | 0.6204 | 0.7361 |
| FCN | 0.7829 | 0.6787 | 0.5137 | 0.6126 |
| SegNet | 0.7663 | 0.6383 | 0.4688 | 0.5469 |
| DeeplabV3+ | 0.7945 | 0.6912 | 0.5281 | 0.6116 |
| R-Net | 0.8118 | 0.7663 | 0.6211 | 0.7256 |
| RC-Net | 0.8186 | 0.7769 | 0.6352 | 0.7393 |
| **RC-MSFNet** | **0.82661** | **0.7821** | **0.6380** | **0.7422** |

1 Bold text indicates the optimal values for each column.