



Adding to Ship Detection Example

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Overview of Talk

- Extracting the contours surrounding the blobs
- Using ossimGeoPolygon to store shapes
- Write contours to a Google Earth KML
- Writing the contours to an ESRI shapefile
- Masking out land using a shoreline shapefile
- Conclusions

Extracting the contours surrounding the blobs

•cvFindContours()

•/* contour retrieval mode */

•#define CV_RETR_EXTERNAL 0

•#define CV_RETR_LIST 1

•#define CV_RETR_CCOMP 2

•#define CV_RETR_TREE 3

•/* contour approximation method */

•#define CV_CHAIN_CODE 0

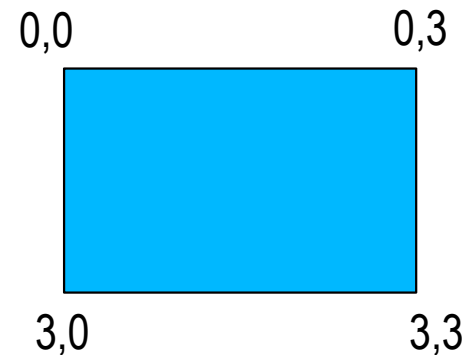
•#define CV_CHAIN_APPROX_NONE 1

•#define CV_CHAIN_APPROX_SIMPLE 2

•#define CV_CHAIN_APPROX_TC89_L1 3

•#define CV_CHAIN_APPROX_TC89_KCOS 4

•#define CV_LINK_RUNS 5



→ (0,0)(0,1)(0,2)(0,3)(1,3)(2,3)(3,3)(3,2)(
3,1)(3,0)(2,0)(1,0)(0,0)

→ (0,0)(0,3)(3,3)(3,0)(0,0)

Extracting the contours surrounding the blobs

- `int cvFindContours(CvArr* image, CvMemStorage* storage, CvSeq** first_contour, int header_size=sizeof(CvContour), int mode=CV_RETR_LIST, int method=CV_CHAIN_APPROX_SIMPLE, CvPoint offset=cvPoint(0, 0))` Finds the contours in a binary image.
- Parameters: *image* – The source, an 8-bit single channel image. Non-zero pixels are treated as 1's, zero pixels remain 0's - the image is treated as binary. To get such a binary image from grayscale, one may use [*Threshold*](#), [*AdaptiveThreshold*](#) or [*Canny*](#). The function modifies the source image's content
- *storage* – Container of the retrieved contours
- *first_contour* – Output parameter, will contain the pointer to the first outer contour
- *header_size* – Size of the sequence header, if , and otherwise

Extracting the contours surrounding the blobs

- *mode* – Retrieval mode

- **CV_RETR_EXTERNAL** - retrieves only the extreme outer contours
- **CV_RETR_LIST** - retrieves all of the contours and puts them in the list
- **CV_RETR_CCOMP** - retrieves all of the contours and organizes them into a two-level hierarchy: on the top level are the external boundaries of the components, on the second level are the boundaries of the holes
- **CV_RETR_TREE** - retrieves all of the contours and reconstructs the full hierarchy of nested contours

- *method* – Approximation method (for all the modes, except CV_LINK_RUNS, which uses built-in approximation)

- **CV_CHAIN_CODE** - outputs contours in the Freeman chain code. All other methods output polygons (sequences of vertices)
- **CV_CHAIN_APPROX_NONE** - translates all of the points from the chain code into points
- **CV_CHAIN_APPROX_SIMPLE** - compresses horizontal, vertical, and diagonal segments and leaves only their end points
- **CV_CHAIN_APPROX_TC89_L1, CV_CHAIN_APPROX_TC89_KCOS** - applies one of the flavors of the Teh-Chin chain approximation algorithm.
- **CV_LINK_RUNS** - uses a completely different contour retrieval algorithm by linking horizontal segments of 1's. Only the CV_RETR_LIST retrieval mode can be used with this method.

Extracting the contours surrounding the blobs

- *offset* – Offset, by which every contour point is shifted. This is useful if the contours are extracted from the image ROI and then they should be analyzed in the whole image context
- The function retrieves contours from the binary image and returns the number of retrieved contours. The pointer `first_contour` is filled by the function. It will contain a pointer to the first outermost contour or NULL if no contours are detected (if the image is completely black). Other contours may be reached from `first_contour` using the `h_next` and `v_next` links. The sample in the [DrawContours](#) discussion shows how to use contours for connected component detection. Contours can be also used for shape analysis and object recognition - see `squares.c` in the OpenCV sample directory.



Extracting the contours surrounding the blobs

```
CvMemStorage* storage = cvCreateMemStorage(0);
CvSeq* contours = NULL;
cvFindContours(blobMask, storage, &contours, sizeof(CvContour), CV_RETR_LIST, CV_CHAIN_APPROX_NONE);
int contourCount = 0;

for(CvSeq* currentContour = contours; currentContour!=NULL; currentContour=currentContour->h_next)
{
    contourCount++;
    vector<ossimGpt> contour;
    for(int contourPosition = 0; contourPosition < currentContour->total; ++contourPosition)
    {
        CvPoint* p = CV_GET_SEQ_ELEM(CvPoint, currentContour, contourPosition);
        contourPoint = ossimIpt(p->x-offset, p->y-offset) + iUpperLeftTilePoint;
        ossimDpt temp_dpt = ossimDpt(contourPoint.x, contourPoint.y);
        ossimGpt temp_gpt;
        geom->localToWorld(temp_dpt, temp_gpt);
        contour.push_back(temp_gpt);
        //writer.writePlacemark("contour points","",temp_gpt.lat, temp_gpt.lon, 0);
    }
    polygons.push_back(contour);
}
currentBlobNumber++;
cvReleaseMemStorage(&storage);
}
```


Using ossimGeoPolygon to store shapes

- **ossimGeoPolygon**

- OSSIM data structure for holding polygons in world coordinates (latitude/longitude)
- An ossimGeoPolygon is just a vector<ossimGpt>

- **ossimGpt**

- OSSIM data structure for holding world coordinates (latitude/longitude)
- ossimImageGeometry::localToWorld takes an image coordinate (ossimDpt) and returns a world coordinate (ossimGpt)

Using ossimGeoPolygon to store shapes

- We can add a private variable to our shipDetectionFilter
- `vector<ossimGeoPolygon> polygons;`
- Then when we extract the coordinates from the blobs we can store them in this variable
- Some important steps
 - `vector<ossimGpt> contour;`
 - `geom->localToWorld(temp_dpt, temp_gpt);`
 - `contour.push_back(temp_gpt);`
 - `polygons.push_back(contour);`

Writing the contours to a Google Earth KML

- Now that we have the coordinates from the blobs extracted using `cvFindContours()` and stored using a `ossimGeoPolygon` in our `shipDetectionFilter` class, we can now write them to files
- A good place to add this function is either in the destructor, or as a method that we are able to call after the chain has finished executing
 - We want to make sure that we call these functions only once at the end of writing to avoid re-writing the files repeatedly as would be the case if we put this code in the `getTile()` function

Writing the contours to a Google Earth KML

We will add a Placemark for each contour that we extract

```
void kmlWriter::writePolygon(string name, string description, ossimGeoPolygon& coordinates, int extrude, int tessellate, string altitude){
    _stream << "<Placemark>" << endl;
    _stream << "<name>" << name << "</name>" << endl;
    _stream << "<description>" << description << "</description>" << endl;
    _stream << "<Polygon>" << endl;
    _stream << "<extrude>" << extrude << "</extrude>" << endl;
    _stream << "<tessellate>" << tessellate << "</tessellate>" << endl;
    _stream << "<altitudeMode>" << altitude << "</altitudeMode>" << endl;
    _stream << "<outerBoundaryIs>" << endl;
    _stream << "<LinearRing>" << endl;
    _stream << "<coordinates>" << endl;
    for(int i = 0; i < coordinates.size(); i++){
        _stream << "" << setprecision(15) << coordinates[i].lon << "," << coordinates[i].lat << "," << coordinates[i].hgt << endl;
    }
    _stream << "</coordinates>" << endl;
    _stream << "</LinearRing>" << endl;
    _stream << "</outerBoundaryIs>" << endl;
    _stream << "</Polygon>" << endl;
    _stream << "</Placemark>" << endl;
}
```



Writing the contours to an ESRI Shapefile

- <http://shapelib.maptools.org/>
- **.SHP File API**
 - http://shapelib.maptools.org/shp_api.html

Writing the contours to an ESRI Shapefile

- **Shape Types**

- Shapes have types associated with them. The following is a list of the different shapetypes supported by Shapefiles. At this time all shapes in a Shapefile must be of the same type (with the exception of NULL shapes).

- #define SHPT_NULL 0

- 2D Shape Types (pre ArcView 3.x):

- #define SHPT_POINT 1 Points

- #define SHPT_ARC 3 Arcs (Polylines, possible in parts)

- #define SHPT_POLYGON 5 Polygons (possible in parts)

- #define SHPT_MULTIPPOINT 8 MultiPoint (related points)

Writing the contours to an ESRI Shapefile

- 3D Shape Types (may include "measure" values for vertices):
 - #define SHPT_POINTZ 11
 - #define SHPT_ARCZ 13
 - #define SHPT_POLYGONZ 15
 - #define SHPT_MULTIPPOINTZ 18
- 2D + Measure Types:
 - #define SHPT_POINTM 21
 - #define SHPT_ARCM 23
 - #define SHPT_POLYGONM 25
 - #define SHPT_MULTIPPOINTM 28 Complex (TIN-like) with Z, and Measure:
 - #define SHPT_MULTIPATCH 31

Writing the contours to an ESRI Shapefile

- **SHPObjct**

- An individual shape is represented by the SHPObjct structure. SHPObjct's created with SHPCreateObject(), SHPCreateSimpleObject(), or SHPReadObject() should be disposed of with SHPDestroyObject().

Writing the contours to an ESRI Shapefile

- typedef struct {
- int nSHPTType; Shape Type (SHPT_* - see list above)
- int nShapeld; Shape Number (-1 is unknown/unassigned)
- int nParts; # of Parts (0 implies single part with no info)
- int *panPartStart; Start Vertex of part
- int *panPartType; Part Type (SHPP_RING if not SHPT_MULTIPATCH)
- int nVertices; Vertex list
- double *padfX;
- double *padfY;
- double *padfZ; (all zero if not provided)
- double *padfM; (all zero if not provided)
- double dfXMin; Bounds in X, Y, Z and M dimensions
- double dfYMin; double dfZMin; double dfMMin; double dfXMax; double dfYMax;
double dfZMax; double dfMMax; } SHPObject;



Writing the contours to an ESRI Shapefile

```
SHPObject * SHPCreateObject(  
int nSHPTType,  
int iShape,  
int nParts,  
int * panPartStart,  
int * panPartType,  
int nVertices,  
double *padfX, double * padfY, double *padfZ,  
double *padfM );
```



Writing the contours to an ESRI Shapefile

```
void shipDetectionFilter::writeShpFile(){
    ossimFilename shapefileName("detections.shp");
    SHPHandle hSHP = SHPCreate(shapefileName.c_str(), SHPT_POLYGON);

    SHPObject *psObject;
    if(hSHP == NULL){
        cout << "Shapefile could not be created" << endl;
    }

    DBFHandle hDBF;
    hDBF = DBFCreate(shapefileName.c_str());

    //Add all fields that we wish to access from DBF
    DBFAddField(hDBF, "Area", FTString, 30, 0);

    for(int i = 0; i<polygons.size(); i++){
        int nVertices = polygons[i].size();

        int* panParts = new int[nVertices+1];
        double* padfX = new double[nVertices+1];
        double* padfY = new double[nVertices+1];
```

Writing the contours to an ESRI Shapefile

```
for(int j=0; j<nVertices; j++){
    padfX[j] = polygons[i][j].lon;
    padfY[j] = polygons[i][j].lat;
    //padfZ[j] = polygons[i][j].hgt;
}
//the last must be equal to the first
padfX[nVertices] = polygons[i][0].lon;
padfY[nVertices] = polygons[i][0].lat;

psObject = SHPCreateObject(SHPT_POLYGON, -1, 1, panParts, NULL, nVertices + 1,
    padfX, padfY, NULL, NULL);
SHPWriteObject(hSHP, -1, psObject );
DBFWriteStringAttribute(hDBF, i, 0, ossimString::toString(polygons[i].area()));
SHPDestroyObject(psObject );
delete [] panParts;
delete [] padfX;
delete [] padfY;
}

SHPClose(hSHP );
DBFClose( hDBF );
}
```

Masking out land using a shoreline shapefile

- You may have discovered that there are MANY false alarms for the ship detector coming from land
- To combat this, we can mask out the land before processing
- OSSIM has a class which makes this easy for us
- `ossimMaskFilter`
 - We can add this to the image chain before our `shipDetectionFilter` to allow our filter to only see parts of the image with water
 - Can work with a shapefile input such as the world vector shoreline



Masking out land using a shoreline shapefile

```
//mask land
ossimRefPtr<ossimImageHandler> inputShp =
ossimImageHandlerRegistry::instance()->open(inputShpName);
cout << "Creating mask filter..." << endl;
ossimRefPtr<ossimMaskFilter> maskFilt = new ossimMaskFilter();
if ( inputShp.valid() ){
if ( inputShp->getClassName() == "ossimOgrGdalTileSource" ){
ossimViewInterface* shpView = PTR_CAST(ossimViewInterface, inputShp.get());
if (shpView){
// Test masking image handler and shape file.
// Set the shape reader's view to that of the image's.
shpView->setView(ih->getImageGeometry().get());
// Turn fill on...
ossimRefPtr<ossimProperty> fillProp =
new ossimStringProperty(ossimString("fill_flag"),
ossimString("1"));
inputShp->setProperty(fillProp);

//ossimRefPtr<ossimMaskFilter> maskFilt = new ossimMaskFilter();
maskFilt->setMaskType(ossimMaskFilter::OSSIM_MASK_TYPE_INVERT);
maskFilt->connectMyInputTo(0, ih.get());
maskFilt->setMaskSource(inputShp.get());
maskFilt->initialize();
}
}
}
```