spatial resolution with only a few pixels (e.g., five pixels long and two pixels wide). In order to manually classify vehicles captured in an aerial image, an individual would have to be trained to identify very fine details in the aerial image in order to classify each vehicle into over hundreds of different classification and sub-classification combinations. Additionally, manual classification can often be inaccurate due to poor image quality of aerial imagery and/or lighting differences, terrain differences, and/or seasonal differences in aerial imagery.

[0004] Existing AI methodologies are insufficient to automatically classify vehicles captured in aerial images due to how small the vehicles appear in the captured images and/or poor image quality. A vehicle can appear indistinguishable due to its small size in the image and/or due to poor image quality that obscures some or all of the vehicles in the image. Thus, an AI model may output inaccurate classifications or fail to classify vehicles captured in the image. Additionally, significantly large training sets are necessary to sufficiently train an AI model due to the large number of possible classifications for any given vehicle captured in an image. A cost (e.g., time, money, resources, etc.) to generate the large training set can outweigh any benefits.

[0005] Existing technology is insufficient to classify vehicles in aerial imagery at a large-scale in an accurate and efficient manner. Thus, by using existing technology, a classification of a vehicle may be inaccurate and/or be determined too late for any worthwhile intelligence to be derived from the classification.

SUMMARY

[0005a] In an aspect, the present disclosure refers to a non-transitory computer-readable medium comprising memory with instructions encoded thereon, the instructions, when executed, causing one or more processors to perform operations, the instructions comprising instructions to:

receive an aerial image of a geographic area that includes one or more aircrafts;

input the aerial image into a machine learning model;

receive, as output from the machine learning model, for each aircraft of the one or more aircrafts:

a bounding polygon corresponding to the aircraft,

a classification, and

a plurality of keypoints; and

for each aircraft of the one or more aircrafts, based on the output of the machine learning model:

determine a set of geometric measurements corresponding to the aircraft,

compare the set of geometric measurements to a plurality of known sets of geometric measurements corresponding to the aircraft classification,

identify, based on the comparison, a known set of geometric measurements from the plurality of known sets of geometric measurements, the known set being mapped by a database to a sub-classification, and

output the sub-classification.

[0005b] In another aspect, the present disclosure refers to a system comprising:

memory with instructions encoded thereon; and

one or more processors that, when executing the instructions, are caused to perform operations comprising:

receiving an aerial image of a geographic area that includes one or more aircrafts;

inputting the aerial image into a machine learning model;

receiving, as output from the machine learning model, for each aircraft of the one or more aircrafts:

a bounding polygon corresponding to the aircraft,

an classification, and

a plurality of keypoints; and

for each aircraft of the one or more aircrafts, based on the output of the machine learning model:

determining a set of geometric measurements corresponding to the aircraft,

comparing the set of geometric measurements to a plurality of known sets of geometric measurements corresponding to the aircraft classification,

identifying, based on the comparison, a known set of geometric measurements from the plurality of known sets of geometric measurements, the known set being mapped by a database to a sub-classification, and

outputting the sub-classification.

[0005c] In another aspect, the present disclosure refers to a method, comprising:

receiving an aerial image of a geographic area that includes one or more aircrafts;

inputting the aerial image into a machine learning model;

receiving, as output from the machine learning model, for each aircraft of the one or more aircrafts:

a bounding polygon corresponding to the aircraft,

an classification, and

a plurality of keypoints; and

for each aircraft of the one or more aircrafts, based on the output of the machine learning model:

determining a set of geometric measurements corresponding to the aircraft,

comparing the set of geometric measurements to a plurality of known sets of geometric measurements corresponding to the aircraft classification,

identifying, based on the comparison, a known set of geometric measurements from the plurality

of known sets of geometric measurements, the known set being mapped by a database to a sub-classification, and

outputting the sub-classification.

[0006] A system and process for automating classification of vehicles captured in aerial imagery is disclosed herein. In an example, the system and process classifies an aircraft (vehicle) captured in a satellite image (aerial imagery) quickly and accurately. Technical improvements are disclosed herein, including a machine learning model that identifies and

provides meaningful information about each vehicle (e.g., about each aircraft) captured in an aerial image. The information is further analyzed by the system via a heuristics-based approach to determine a set of geometric measurements for each vehicle. The set of geometric measurements are compared to known sets of geometric measurements stored in a database. The comparison provides a unique sub-classification (e.g., a make and model) of each vehicle. Disclosed by way of example are computer program products (e.g., a non-transitory computer-readable storage media that stores instructions executable by one or more processors), a method, and/or a system for analyzing an aerial image from an aerial imaging device to classify each vehicle in the image.

[0007] In one example, an aircraft classification system is disclosed that receives an aerial image of a geographic area that includes one or more aircrafts. The aircraft classification system further inputs the aerial image into a machine learning model. For each aircraft of the one or more aircrafts, the aircraft classification system receives output from the machine learning model. The output includes a bounding polygon corresponding to the aircraft, a classification, and a plurality of keypoints. For each aircraft of the one or more aircrafts and based on the output of the machine learning model, the aircraft classification system determines a set of geometric measurements corresponding to the aircraft, compares the set of geometric measurements to a plurality of known sets of geometric measurements corresponding to the classification, and identifies, based on the comparison, a known set of geometric measurements from the plurality of known sets of geometric measurements. The known set is mapped by a database to a sub-classification. The aircraft classification system outputs the sub-classification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The disclosed embodiments have advantages and features which will be more readily