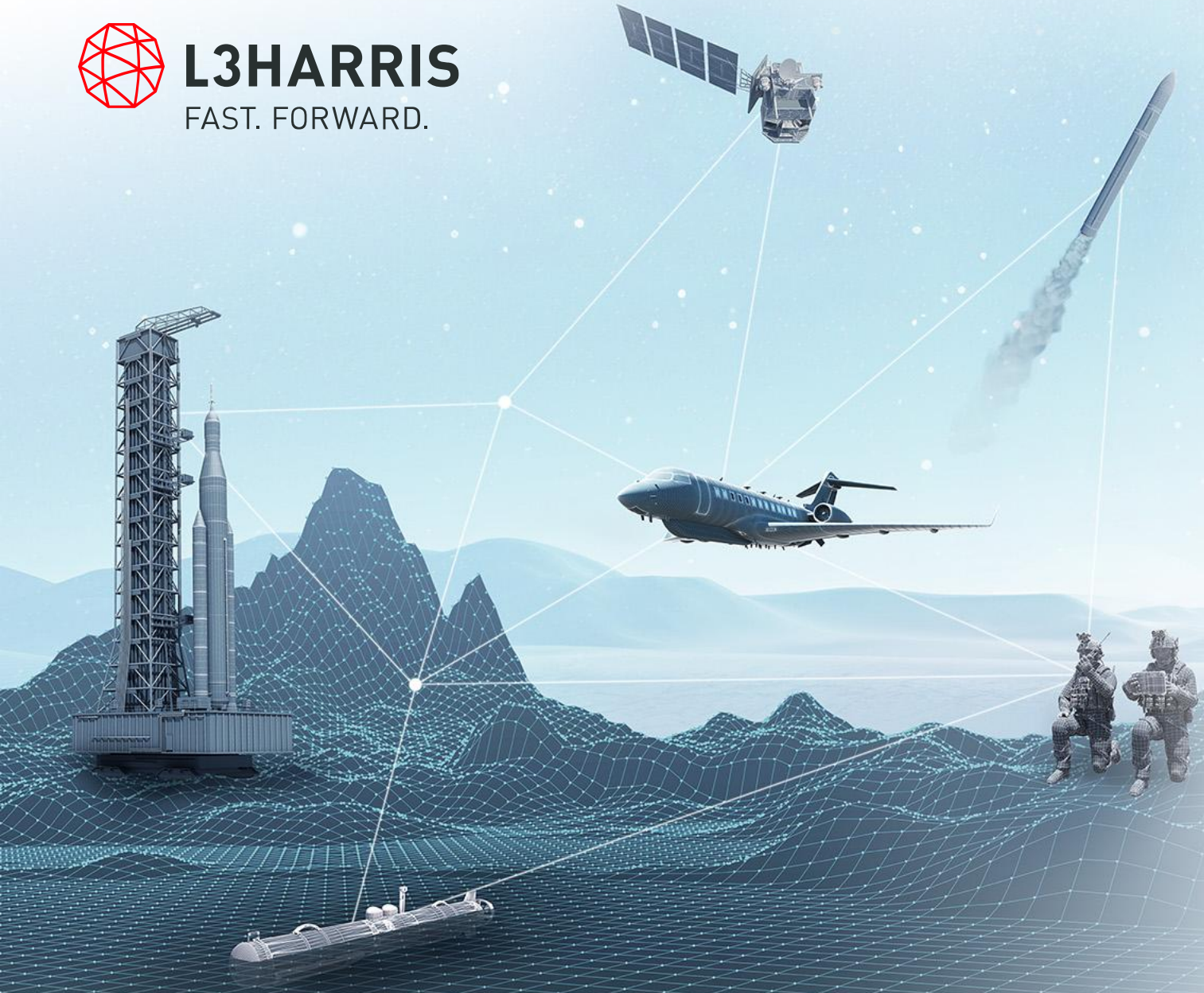


L3HARRIS
FAST. FORWARD.

BUNDLE VARIANCE AND STANDARDIZATION

2025 Summer Internship Final Presentation

ANTHONY GUARINO | SW-Image Science Intern

August 05, 2025

Use of U.S. Department of Defense visual information does not imply or constitute DOD endorsement.

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

RIT

College of Science

Chester F. Carlson Center for Imaging Science

Maverick - Patronus

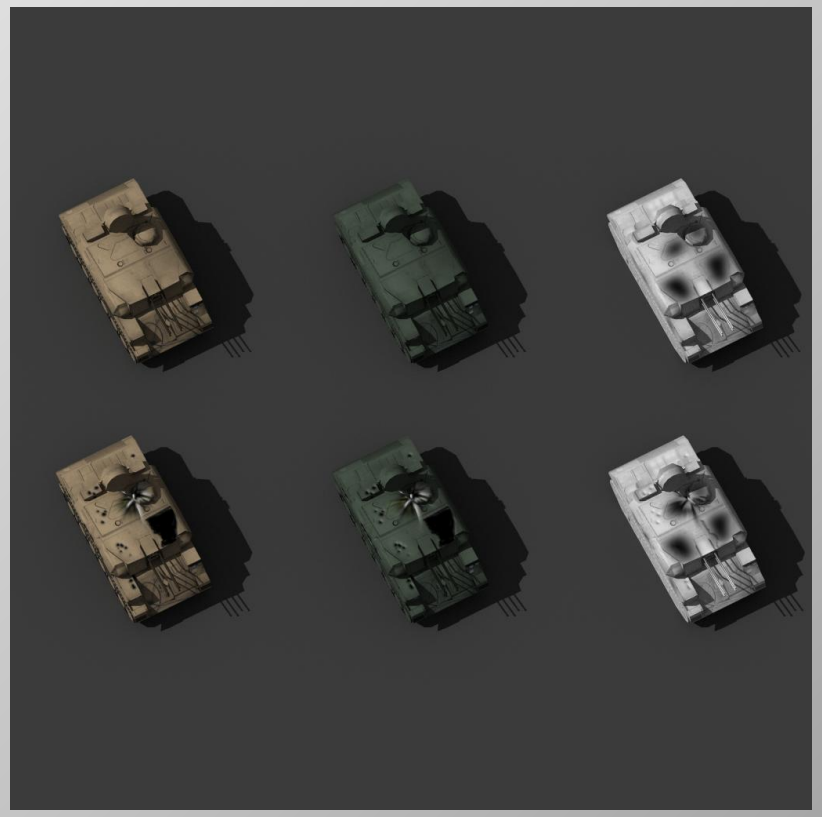
Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Patronus Simulation

DIRS
Digital Imaging and
Remote Sensing Lab

Material Variation



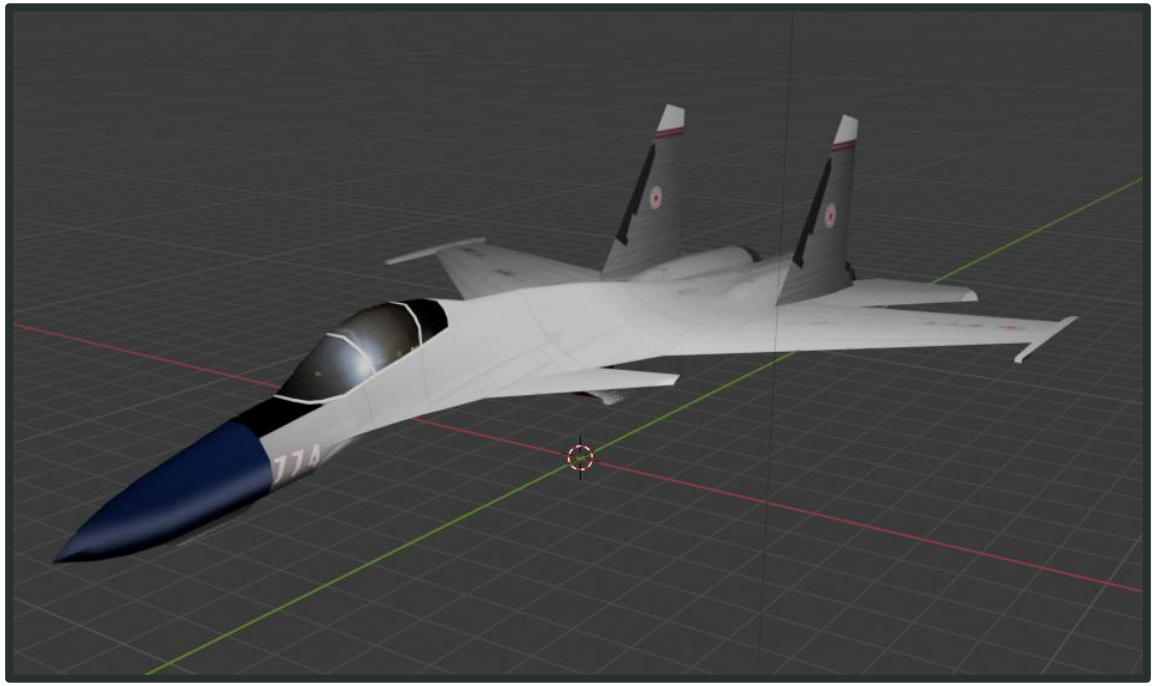
6 Variants of the ZSU-23-4 Tank

Bundle Architecture

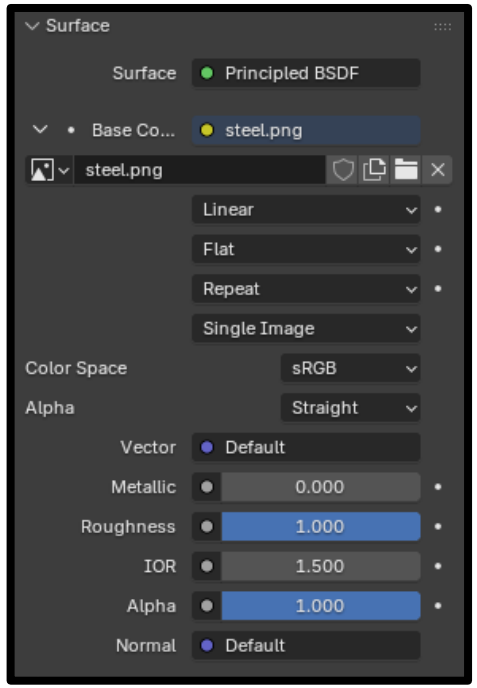
```
Example-bundle/
├ materials/
│  ├ emissivities.ems
│  ├ textures.png
├ Example-bundle-random.glist
├ Example-bundle.glist
├ Example-bundle.mat
├ Example-bundle.obj
├ Example-bundle.yaml
├ preview.png
```

Bundle Variance and Standardization

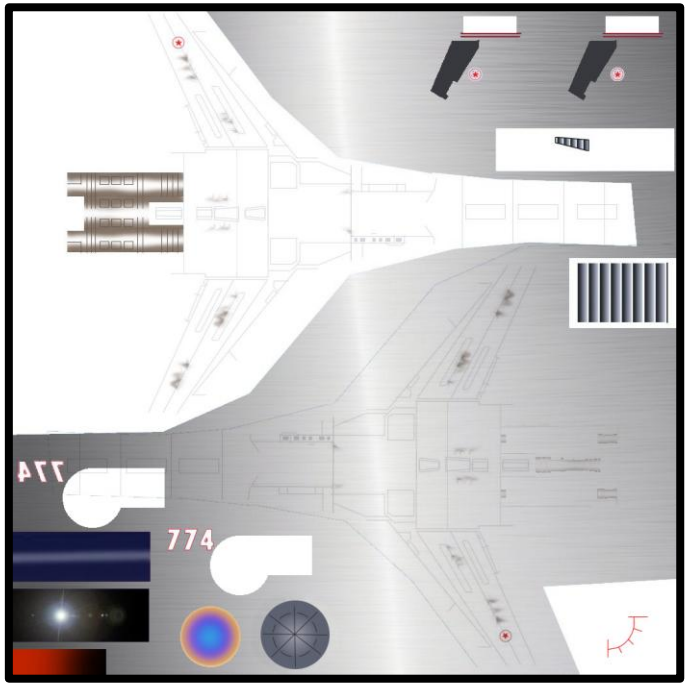
Anthony Guarino – Maverick Patronus



FighterJet-SU27



Material Properties



Texture File

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Bundle Files

→ Object File

Material File

Geometry List Files

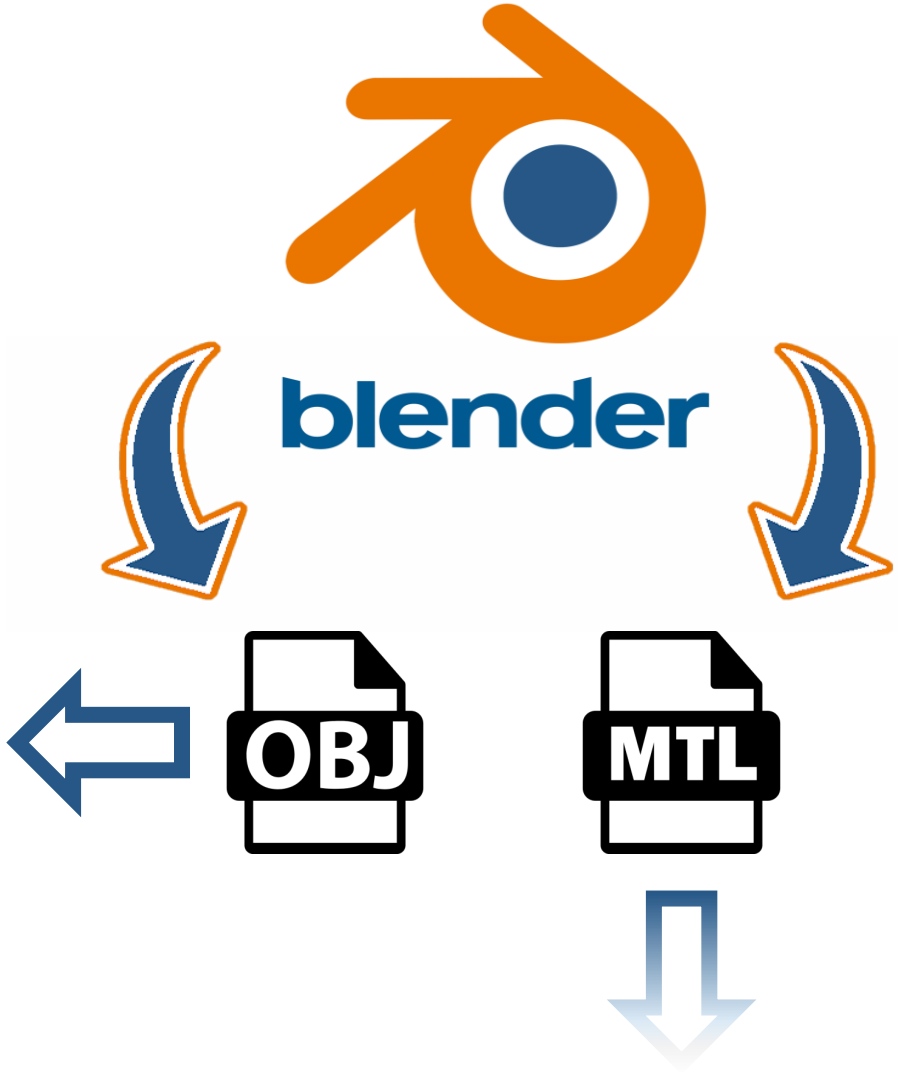
Information File

Preview Image

Material Folders

Bundle Object File

```
o Target-Bundle
v 0.172057 -8.452310 3.077982
v 0.184643 -7.586110 3.206381
v 0.009579 -7.586380 3.208863
v 0.009579 -8.452570 3.080339
v 0.473641 -6.885410 3.110348
v 0.417571 -7.191790 3.108862
v 0.469373 -7.547950 3.038908
v 0.347352 -7.384120 3.130523
v 0.208431 -7.564810 3.195235
v -0.189272 -7.564810 3.195235
v -0.328194 -7.384120 3.130523
v -0.450215 -7.547950 3.038908
v -0.398413 -7.191790 3.108862
v -0.454483 -6.885410 3.110348
v -0.165484 -7.586110 3.206381
v -0.152899 -8.452310 3.077982
v 0.435890 -8.434870 2.916209
v -0.416732 -8.434870 2.916209
vn 0.3686 -0.1778 0.9124
vn -0.0001 -0.2459 0.9693
vn -0.0004 -0.1828 0.9832
vn 0.8305 -0.1038 0.5473
vn 0.6632 -0.1421 0.7348
vn 0.6920 -0.0997 0.7150
...
```



Bundle Variance and Standardization

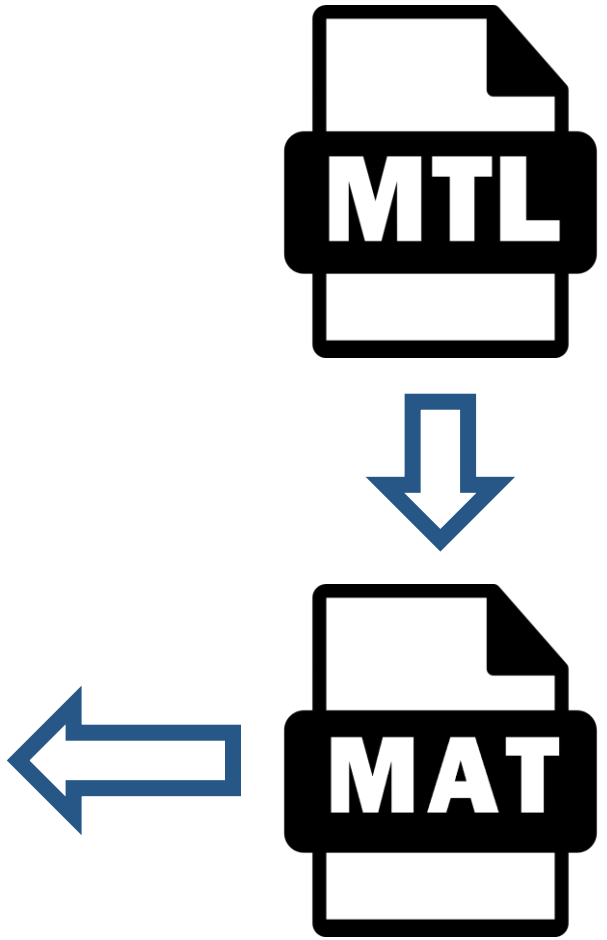
Anthony Guarino – Maverick Patronus

Bundle Files

- Object File
- → Material File
- Geometry List Files
- Information File
- Preview Image
- Material Folders

Bundle Material File

```
MATERIAL_ENTRY {
    ID           = material_name
    NAME         = RGB
    EDITOR_COLOR = 1, 1, 1

    SURFACE_PROPERTIES {
        REFLECTANCE_PROP_NAME = RgbImage
        REFLECTANCE_PROP {
            IMAGE_FILENAME = materials/mat.png
            SCALE = 0.003
            UV_PROJECTOR {
                ORIGIN = IMAGE
                FLIPX = FALSE
                FLIPY = TRUE
                EXTENDX = MIRROR
                EXTENDY = MIRROR
            }
        }
    }

    RAD_SOLVER_NAME = Simple
    RAD_SOLVER {
        QUALITY = High
    }
}
```



Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Bundle Files

Object File

Material File

→ Geometry List Files

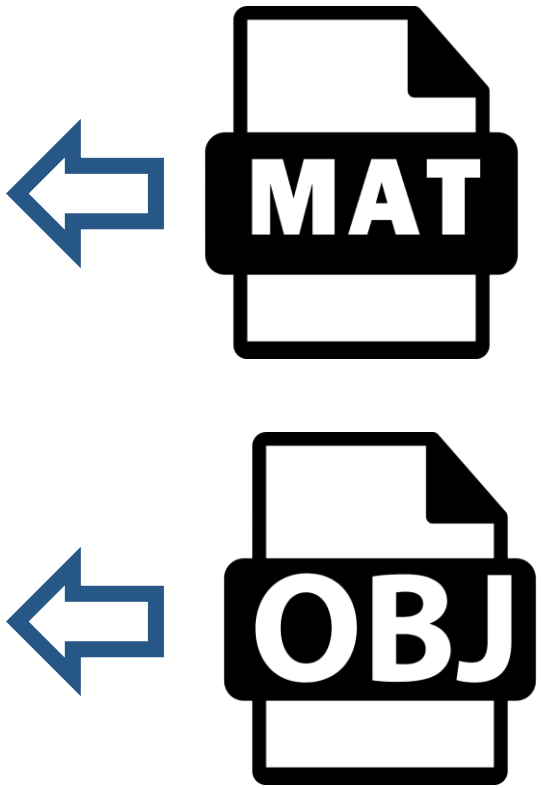
Information File

Preview Image

Material Folders

Bundle Geometry List File

```
<geometrylist>
  <object search_paths="local">
    <localmaterials>Target-Bundle.mat</localmaterials>
    <basegeometry>
      <obj swapyz="false">
        <filename>Target-Bundle.obj</filename>
        <assign id="material_name">texture</assign>
      </obj>
    </basegeometry>
  </object>
</geometrylist>
```



Bundle Variance and Standardization

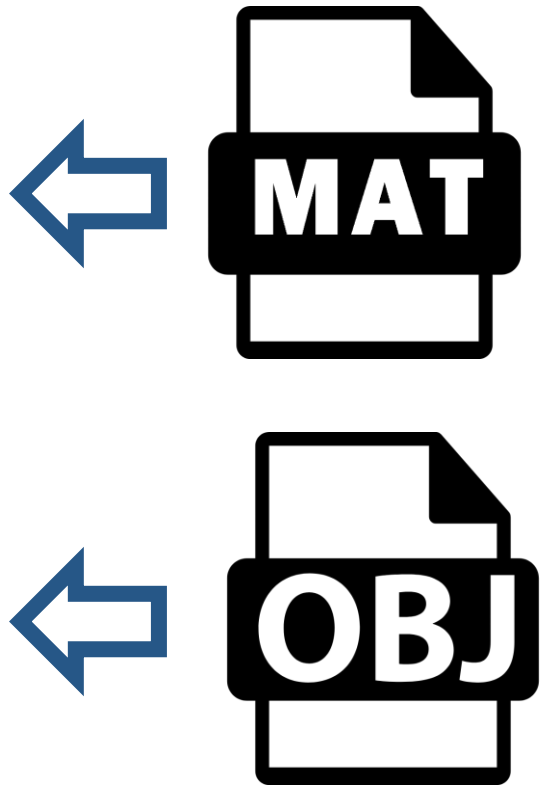
Anthony Guarino – Maverick Patronus

Bundle Files

- Object File
- Material File
- → Geometry List Files
- Information File
- Preview Image
- Material Folders

Material Variant Bundle Geometry List File

```
<geometrylist>
  <object search_paths="local">
    <localmaterials>Target-Bundle.mat</localmaterials>
    <basegeometry>
      <obj swapyz="false">
        <filename>Target-Bundle.obj</filename>
        <assign id="variant">texture</assign>
      </obj>
    </basegeometry>
    <population>
      <materialvariant>
        <variantid>variant</variantid>
        <distribution>
          <matid weight="1">material_name</matid>
          <matid weight="1">material_name_2</matid>
          <matid weight="1">material_name_3</matid>
          <matid weight="1">material_name_4</matid>
        </distribution>
      </materialvariant>
    </population>
  </object>
</geometrylist>
```



Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Bundle Files

- Object File
- Material File
- Geometry List Files
- → Information File
- Preview Image
- Material Folders

Bundle Information File

```yaml
model_name: Target-Bundle
model_filename: Target-Bundle.obj
dimensions: [x, y, z]
bounding_box: [[-x, -y, -z], [x, y, z]]
bandpass: [vis, nir]
source: 3D Model Source
source_location: https://3D-Model-Source.com/this-website-is-not-real
license: Standard royalty free license.
description: Target Bundle from 3D Model Source. Converted for DIRSIG.
comment: Using RGB Texture Maps
default_glist:
  filename: Target-Bundle.glist
  thumbnail: preview.png
  display_name: Target Bundle
random_glist:
  filename: Target-Bundle-random.glist
variant_glists:
  - filename: Target-Bundle.glist
    thumbnail: preview-alt1.png
    display_name: Target Bundle Alternate 1
  - filename: Target-Bundle-alt2.glist
    thumbnail: preview-alt2.png
    display_name: Target Bundle Alternate 2
```

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Bundle Files

Object File

Material File

Geometry List Files

Information File

→ Preview Image

Material Folders

Preview Image File (Thumbnail)

IEI Thumbnail

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Bundle Files

Object File

Material File

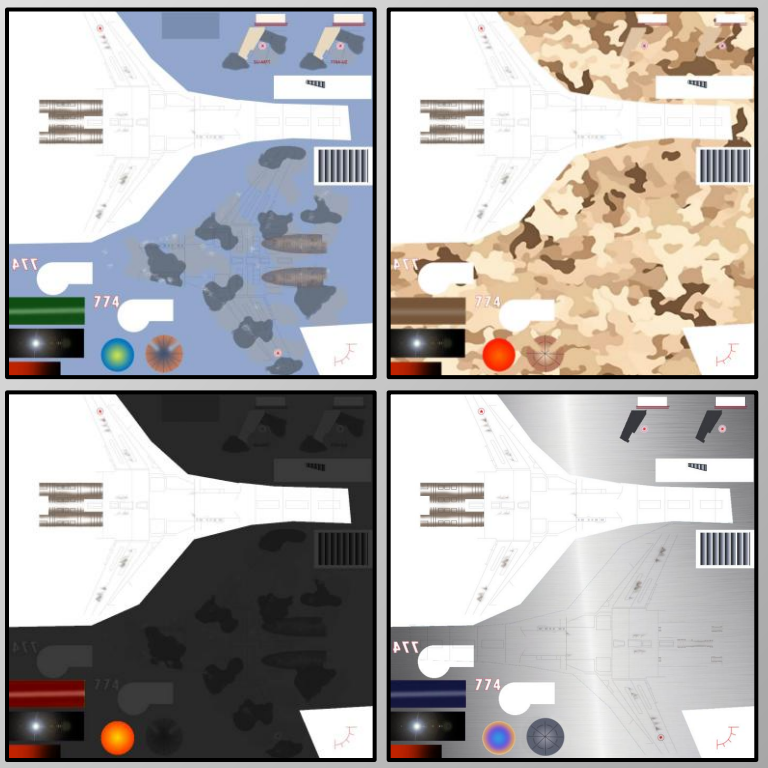
Geometry List Files

Information File

Preview Image

→ Material Folders

Texture Files



Rendered Variants

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Patronus Target Input

```
targets:
- targetBundle: /path/to/bundles/Target-Bundle
  targetLocation: POINT (141.700477 42.832501), 80
- targetBundle: /path/to/bundles/Target-Bundle/Target-Bundle.glist
  targetLocation: POINT (141.6992 42.8327), 0
- targetBundle: /path/to/bundles/Target-Bundle/Target-Bundle-random.glist
  targetLocation: POINT (141.732 42.83417), 0
```

Bundle Folder

Bundle Glist

Random Glist

Pydantic Bundle Info Class

```python
class BundleGlist(BaseModel):
    filename: str | None = None
    thumbnail: str | None = None
    display_name: str | None = None


class BundleInfo(BaseModel):
    model_config = ConfigDict(protected_namespaces=())
    model_name: str | None = None
    model_filename: str | None = None
    dimensions: freyr.pydantic.numpy_ndarray(shape=(3,)) | None = None
    bounding_box: freyr.pydantic.numpy_ndarray(shape=(2, 3)) | None = None
    bandpass: list[str] | None = None
    source: str | None = None
    source_location: str | None = None
    license: str | None = None
    description: str | None = None
    comment: str | None = None
    default_glist: BundleGlist | None = None
    random_glist: BundleGlist | None = None
    variant_glist: list[BundleGlist] | None = None
```

Help determine more efficiently which glist to use if a bundle folder path is provided as the targetBundle.

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

DIRSIG Bundle Cleanup

Cleaned up existing bundles and created material variants for them.

Render of Cleaned Up Bundles with Variants

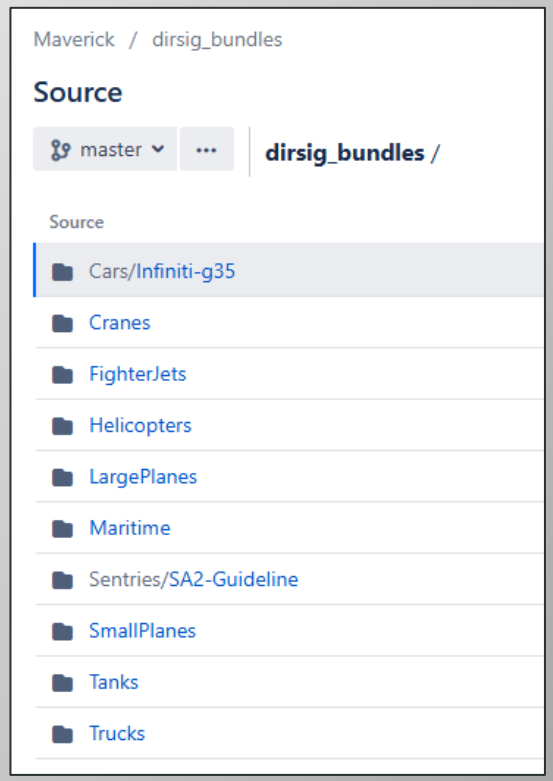
New Maritime Bundles

Created new maritime bundles from CAD models

New Maritime Ships Rendered in DIRSIG

Type 039C Yuan Class Submarine

Bundle Repository



40+ sorted bundles with cleaned up standard format.

Bundle Variance and Standardization

Anthony Guarino – Maverick Patronus

Future Work

Updating unit tests to reference from the new repository

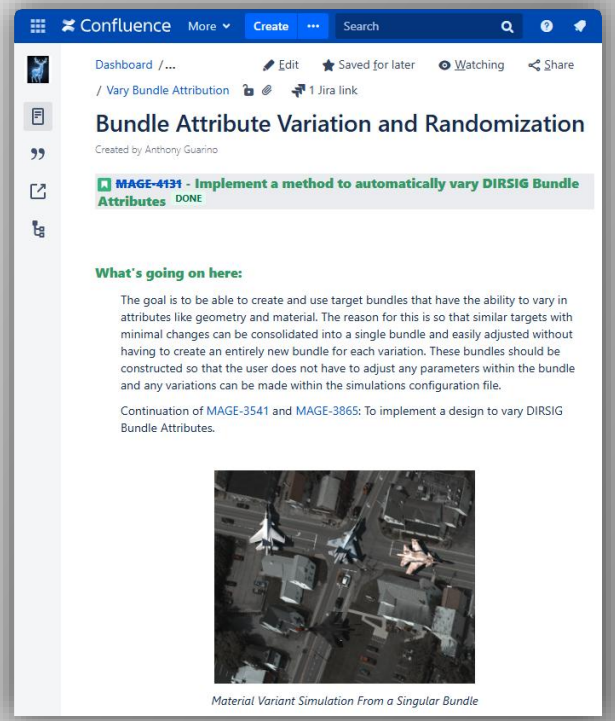
```python
import dirsig_bundles as db

def get_test_bundle_path(*paths, file_pattern=None):
    data_path = os.path.join(os.path.dirname(db.__file__), *paths)
```

```python
self.bundle = get_test_bundle_path("Trucks", "Truck-Blue_Gray_IR")
```

```python
class TestConfigHelper(unittest.TestCase):
    def setUp(self):
        self.expected_x = -86.325786
        self.expected_y = 30.639069
        self.bundle_su_35 = get_test_bundle_path("FighterJets/FighterJet-SU35")
        self.bundle_su_35_glist = self.bundle_su_35 + "/FighterJet-SU35.glist"
        self.bundle_h135 = get_test_bundle_path("Helicopters/Helicopter-H135/"
                                                "Helicopter-H135.glist")
```

Sort bundles by availability and confidentiality

Update Documentation on Bundle Variance Process



Material Variant Simulation From a Singular Bundle

Special Thanks

L3Harris RTP-5:

Karla Bergonzi
Eric Woodward
Malcolm Kotok
Linda McNamara
Balor Brennan
Rachel Messenger
Isander Paris Santiago
Alondra Soto Sanabria

Patronus Team:

Sue Munn
Brian Staab
Gino Coppola
Maisha Maliha
Monica Barbu-McInnis
Phil Salvaggio
Ashley Nussel
Eddie Haskell
Sarah Arends
Robert Simon
ThaoVy Nguyen

Questions?