Synspective, its satellites and Analysis Ready Data

Gerald Baier, PhD
Manager, SAR algorithm unit
Who We Are

Synspective is a Tokyo-based start-up that develops and operates small SAR satellites and solution services using satellite data.

Founded in 2018, the company has raised $200M in 4.5 years.

180+ Members From 27 countries.

Selected as one of the 10 most promising startups in Japan by LinkedIn (2020, 2021, 2022).

CEO Motoyuki Arai selected as one of Business Insider’s 100 People Transforming Business in Asia.

Geospatial World Leadership Award 2022.

Ministry of Education, Culture, Sports, Science and Technology (MEXT) Minister Prize at the Japan Startup Award 2022.

Award for Strategic Projects at World Satellite Business Week (WSBW) 2019.
### StriX specifications

**Mass:** 125kg  
**Size:** 5 x 0.7 x 0.7m (in orbit)  
0.7m Cubic (at launch)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>StriX-α</th>
<th>StriX-β, StriX-1, StriX-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>orbit control</td>
<td>No</td>
<td>Yes (thruster)</td>
</tr>
<tr>
<td>off-nadir angle</td>
<td>15-45 deg</td>
<td></td>
</tr>
<tr>
<td>antenna</td>
<td>passive honeycomb panel slot-array</td>
<td></td>
</tr>
<tr>
<td>center frequency</td>
<td>9.65 GHz</td>
<td></td>
</tr>
<tr>
<td>chirp bandwidth</td>
<td>SM: 75 MHz, SL: 300 MHz</td>
<td></td>
</tr>
<tr>
<td>polarization</td>
<td>VV</td>
<td></td>
</tr>
<tr>
<td>PRF</td>
<td>3000 ~ 7000 Hz</td>
<td></td>
</tr>
<tr>
<td>duty</td>
<td>25%</td>
<td></td>
</tr>
<tr>
<td>transmission power</td>
<td>1000 W</td>
<td></td>
</tr>
<tr>
<td>noise figure</td>
<td>2.6 dB</td>
<td></td>
</tr>
</tbody>
</table>

**StriX Satellite Launches**

Synspective has launched four satellites into target orbit, which have captured high-resolution imagery from all over the world.

<table>
<thead>
<tr>
<th>項目</th>
<th>StriX-α</th>
<th>StriX-β</th>
<th>StriX-1</th>
<th>StriX-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimension (before deployment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approx. 0.7m x 0.7m x 0.7m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dimension (after deployment)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Approx. 5m x 0.7 x 0.7m</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td></td>
<td></td>
<td>100kg level</td>
</tr>
<tr>
<td>Orbit Type</td>
<td>sun-synchronous orbit</td>
<td>sun-synchronous orbit</td>
<td>sun-synchronous orbit</td>
<td>sun-synchronous orbit</td>
</tr>
<tr>
<td>Nominal altitude</td>
<td>500km (*)</td>
<td>561km</td>
<td>561km</td>
<td>561km</td>
</tr>
<tr>
<td>Orbit inclination angle</td>
<td>97.3 degree (*)</td>
<td>97.7 degree</td>
<td>97.7 degree</td>
<td>97.7 degree</td>
</tr>
<tr>
<td>Revisit period</td>
<td>Approx. 5 days (*)</td>
<td>1 day</td>
<td>1 day</td>
<td>1 day</td>
</tr>
<tr>
<td>Local Time at Ascending Node (LTAN)</td>
<td>10:30</td>
<td>21:00</td>
<td>21:00</td>
<td>15:00</td>
</tr>
</tbody>
</table>

* It changes because StriX-α does not maintain orbit.

<table>
<thead>
<tr>
<th>Polarization</th>
<th>VV</th>
<th>VV</th>
<th>VV</th>
<th>VV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch date</td>
<td>2020/12/15</td>
<td>2022/03/01</td>
<td>2022/09/19</td>
<td>2024/03/13</td>
</tr>
<tr>
<td>First image acquisition</td>
<td>2021/02/08/</td>
<td>2022/05/28</td>
<td>2022/12/12</td>
<td>Soon</td>
</tr>
</tbody>
</table>

**Mission Name**

- THE OWL’S NIGHT BEGINS
- THE OWL’S NIGHT CONTINUES
- THE OWL SPREADS ITS WINGS
- OWL NIGHT LONG

※For more information, please download a more detailed data/product guide from our [website](#).
Observation modes

**Stripmap**
- 20 x 50 km
- 3 m resolution (75 MHz)

**Sliding Spotlight**
- 10 x 10 km
- 1 m resolution (300 MHz)

Samples available at [https://synspective.com/gallery/](https://synspective.com/gallery/)
StriX-α
Haneda Airport, Japan
Yu Morishita et al., “Synspective's Small X-Band SAR Satellite (StriX) Constellation and its First InSAR Results,” Fringe 2023
Synspective efforts towards Analysis Ready Data

• Calibration
  • K. Orzel et al. "StriX-α SAR satellite: demonstration of observation modes and initial calibration results" *EUSAR 2022*
  • Masanobu Shimada “Imaging from spaceborne and airborne SARs, calibration, and applications” 2019

• File formats & Metadata
  • CEOS, also used by ALOS-1 and ALOS-2
  • SICD [https://github.com/ngageoint/sarpy](https://github.com/ngageoint/sarpy)
  • Following IEEE standard ([https://sagroups.ieee.org/sar/](https://sagroups.ieee.org/sar/)) development

• Compatibility with 3rd party software
  • GAMMA, [https://www.gamma-rs.ch/software](https://www.gamma-rs.ch/software)
  • SARscape, [https://www.sarmap.ch/index.php/software/sarscape/](https://www.sarmap.ch/index.php/software/sarscape/)
  • SNAP, [https://step.esa.int/main/toolboxes/snap/](https://step.esa.int/main/toolboxes/snap/)
Calibration

- Amazon rainforest
  - Radiometric accuracy
  - Pointing error elevation
- Rosamond corner reflectors
  - Resolution
  - Geometric accuracy
- Doldrums $\rightarrow$ NESZ
- Short term goal: regular (and frequent) calibration reports
  - Missing automation
  - Fighting about capacity

Stripmap acquisition of Amazon rainforest:
Inhomogeneous areas (left)
Amplitude with uncorrected antenna pattern (right)

K. Orzel et al., "The on-orbit demonstration of the small SAR satellite. Initial calibration and observations," 2022 IEEE Radar Conference

Stripmap acquisition of Rosamond corner reflectors
• Great documentation: CEOS-ARD for Synthetic Aperture Radar specifications
  • Will need time to be compliant
  • Additional raster data sound interesting (DEM, shadowing mask, …)
• InSAR
  • Excited about CEOS Geocoded Single-Look Complex images
  • Need to evaluate impact of our baseline accuracy
  • Coregistered Single look Slant range Complex (CoSSC) products?
    • Coherence raster as metadata?
    • Which coherence estimator was used?
• CEOS preferred file formats for L0, L1 and L2?

StriX SL 1-day interferogram:
coherence and phase
Synspective aims to build the Learning World ecosystem with our analytics platform and near real-time SAR data to understand changes anywhere in the world.

**Sustainability**
Our Solutions for the oil & gas, mining, foresting, and clean tech sectors promotes the use of effective and renewable energy and resources.

**Resilience**
Our service for the civil engineering sector enables steady economic growth through resilient and safe infrastructure development and maintenance.

**Peace**
Our service for the D&I sector contributes to the achievement of a peaceful world by reinforcing its information-gathering capability and responsiveness.
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