

Use Cases

CONFIDENTIAL

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To reduce hard, dirty, and dangerous work

Infrastructure Inspection

Visual inspection by humans using elevated vehicles, rope access, etc.

Solving dangerous and immensely time-consuming tasks with non-GPS flight technology



Corrosion inspection of piping in petrochemical plants



Hokkaido Railway Company
This demonstration experiment uses an abandoned railway tunnel (former Kuriyama Tunnel)

Insufficient human resources

- Loss of know-how due to retirement of veterans
- Dispatch of middle class workers to overseas plants
- Overheated competition for human resources

Inspection cost

- Opportunity loss due to shutdown at the plant
- Tens of millions to hundreds of millions (yen) in scaffolding construction costs, etc.

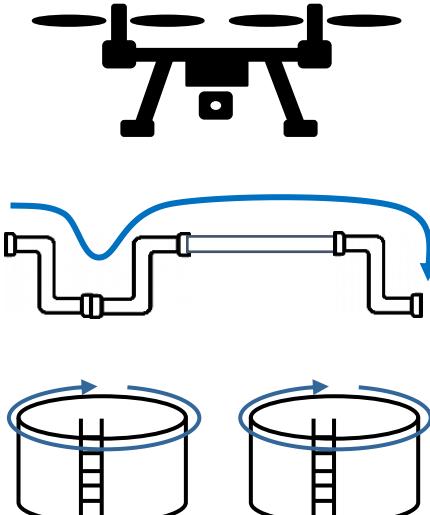
Workers' compensation risk

- Accidents in working at heights, etc.
- Compliance with Fire Service Law and Industrial Safety Law

All inspection work needs to be labor-saving and unmanned

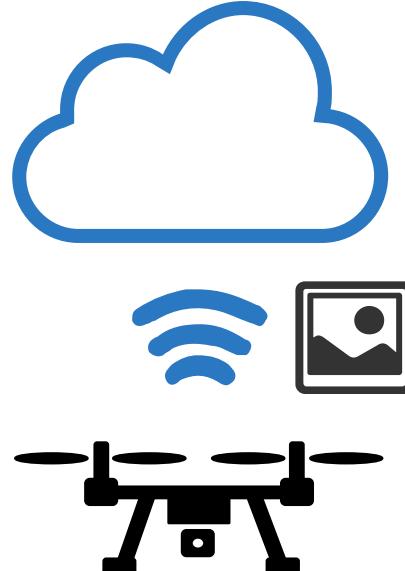
1 Filming and collecting

- Autonomous flight and photography along a specified route



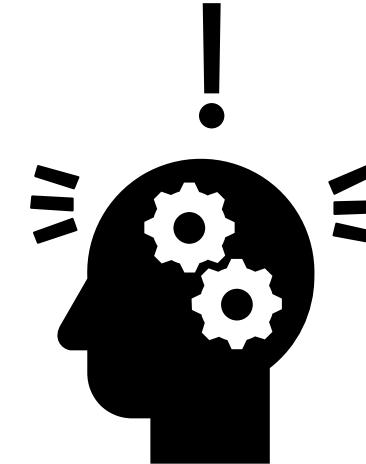
2 Uploading

- Uploading images to the cloud



3 Image Analysis

- AI automatically assesses corrosion and oil leakage



4 Verification of results

- Check analysis results on the Web



非GPS環境下であるプラントの配管点検にドローンを活用

Plant inspection: Pipe inspection in high places and detection of rust



ドローンと点検対象物との距離を一定距離に
保持する技術で安全に飛行し、点検画像の撮影を実施



ドローンで撮影した映像

画像一覧 フライト詳細

#159撮影日時 : 2019-06-06 10:30
スプール図 No.

腐食評価結果 申し送り

構配管 P1 P3
架構接続部 S3

スプール図選択

元データの表示

結果の表示

重ねて表示

スプール図表示

エリア Area1

装置名

部位

配管種別

配管サイズ

MTG報告対象

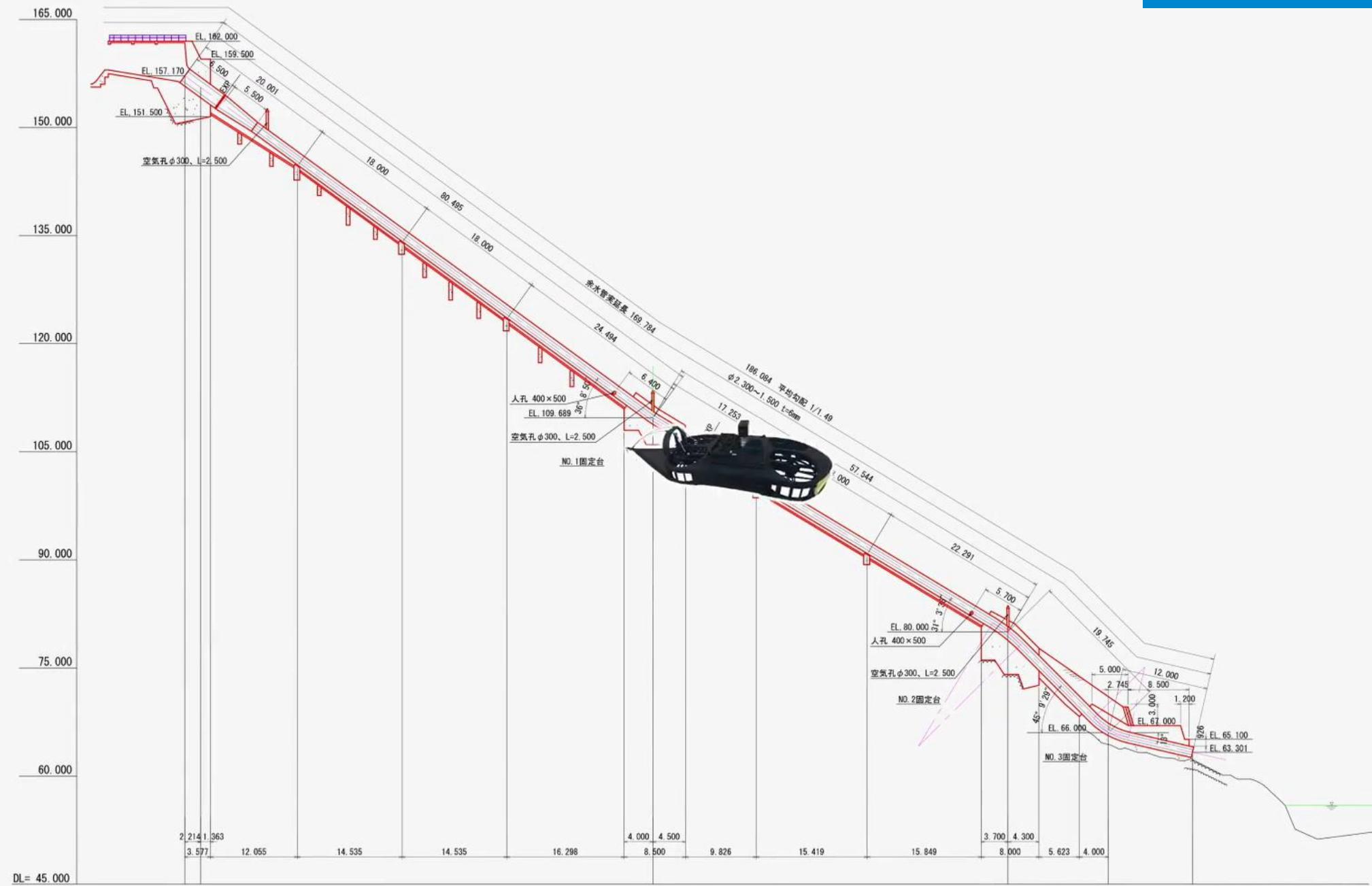
補修状況

撮影距離

誤評価箇所、正しい評価ランク

/ 100

アップデート



Air Slider®による 管水路の点検・調査

十勝管内導水路での実証

ターゲットは、スクリーニング調査です。



20mを約30秒で到達。

Smokestack : Developed by KEPCO based on ACSL drone

ACSL

The smokestack inspection drone developed by KEPCO using ACSL-PF2 conduct on-site demonstrations in actual environments and got satisfactory results. Building evaluation and production system for initial shipments in FY22/03 Q2

Background and Objectives

- **Issues such as safety risks** at heights working and work that takes **several weeks** to complete, etc.
- In August 2020, **ACSL-PF2 was provided to an autonomous drone developed by Kansai Electric Power Co. for smokestack inspection** of smokestack in thermal power plants.
- Kansai Electric Power, KANSO Technos and ACSL collaborate to promote inspection work inside smokestack



Overview of Smokestack Inspection Drones

- **Controlled to always be in the center of the smokestack, stable flight in non-GPS environments**
- Equipped with high-intensity LEDs and a high-definition camera (60 megapixels), can inspect interior walls and detect minute cracks in dark environments



Top left: Smokestack inspection drone (ACSL – PF2)

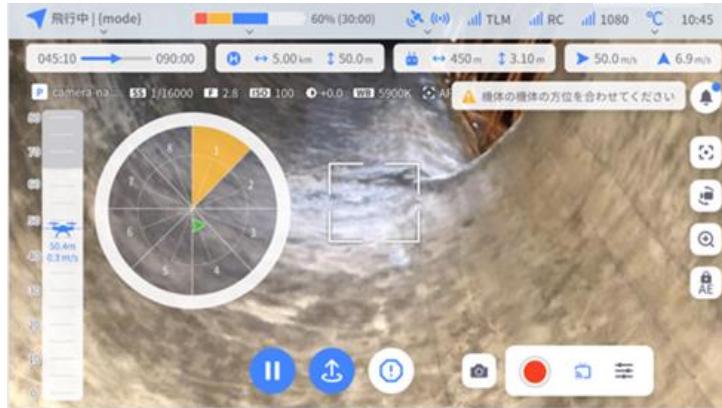
Top right: LiDAR technology which realized drone to estimate its own location, even in dark, hard-to-recognize smokestacks

Bottom: Image of the movie taken from PF2. The upper center is the entrance to the top of the smokestack

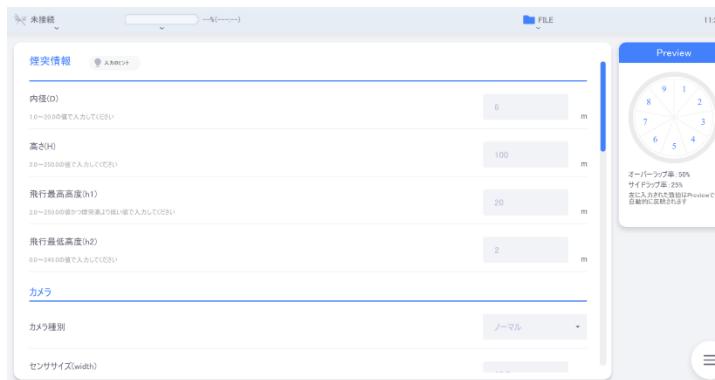
Application-specific drone: chimney inspection

ACSL

GCS1 "Smokestack TAKEOFF", dedicated for drones to inspect the inside smokestack, is now available for order.



GCS screen showing camera images, etc.



Screen for entering required information



Chimney inspection drone

Smokestack TAKE OFF Overview

- Smokestack inspections generally take two to three weeks and present challenges in terms of cost, manpower, safety, etc.
- Began accepting orders for "Smokestack TAKEOFF" as a dedicated base station application for smokestack inspection drones, since it was applied in practice through collaboration with Kansai Electric Power Co.
- Safe flight and inspection data acquisition at the push of a single button, even for first-time operators
 - Optimal flight settings are calculated and routes are created by inputting chimney information and shooting conditions.
 - Automatic flight photography is possible at the touch of a button, enabling real-time confirmation of inspection camera images, etc.

1: Abbreviation for Ground Control Station, an application for piloting drones.

Smokestack inspection





北海道旅客鉄道株式会社提供
本実証実験は、廃線トンネル（旧栗山トンネル）を使用しています

Successfully demonstrated indoor inspection

ACSL

Demand for indoor inspection as a candidate for the next application-specific drone is high. Successfully conducted autonomous indoor inspection with Takenaka Corporation

Indoor inspection at construction site

- Trials conducted at actual construction site with **Takenaka Corporation**, **Kanamoto**, and **Actio**. Autonomous Flight system jointly developed with **Sensyn Robotics** in Nov-21 was used.
- Drones perform **safety patrols and site inspections**, currently done by manned operations.
- Demand for **productizing indoor patrol drone** is high.



Development of pressure regulating water tank inspection drone

ACSL

Development of a non-GPS autonomous drone for inspecting pressure regulating water tank¹ at hydroelectric power plants with Hokkaido Electric Power Co. by applying the application-specific drone in "ACSL Accelerate"

Project background

- Pressure regulating water tank inspection requires workers to suspend themselves from the top and directly check the deteriorated condition, which is **unsafe and inefficient**
- Development of autonomous drone capable of stable flight in a non-GPS, dark environment inside water regulating tank by applying application-specific drone technology**
- ACSL develops drones for non-GPS indoor facility inspections with Hokkaido Electric Power Company

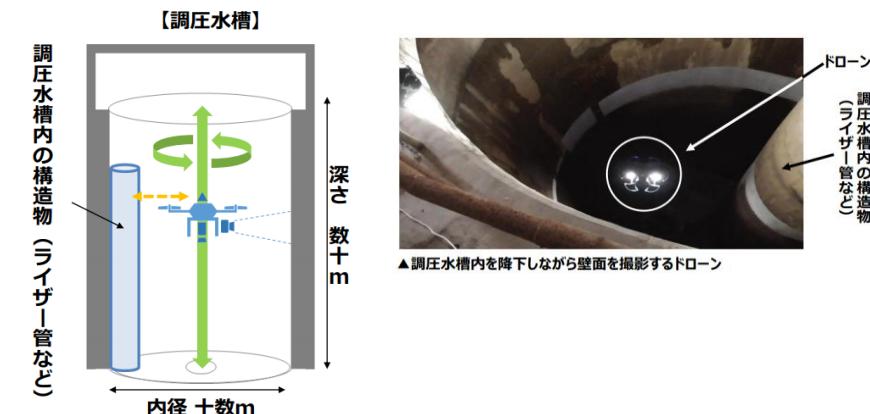
ACSL

ほくてん

1: Pressure regulating water tank: A facility to mitigate water hammer effects caused by sudden changes in power output, such as load interruption of a generator

Overview of inspection drone

- The drone flies while calculating its own location**, using the structure as a landmark in regulating water tank
- Repeatedly fly up and down and turn to take images of the entire inner wall surface.
- Check the condition of the inner wall surface based on the images

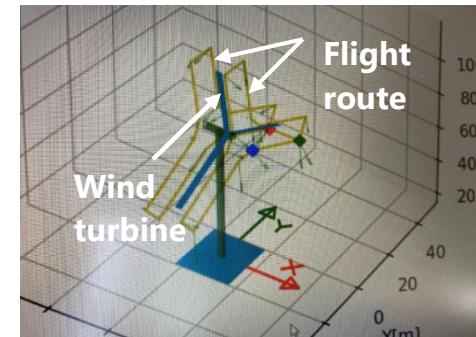


Wind turbine inspection with high-resolution camera

PF2 is equipped with an α7R IV (manufactured by Sony) capable of high-resolution photography. It flies autonomously based on the flight route set along the wind turbine blades, and takes pictures of the entire wind turbine (front and back).

Wind turbine inspection

- Dedicated software allows for **easy generation of flight routes (for wind turbine generators)**
- Detailed images of blade edges and receptors can be obtained by **installing a high-resolution camera**
- **Inspecting with drones is safe and quick** because it is possible to inspect with automatic flight while people are still on the ground
- Inspection time per unit, including preparation, is about 30 minutes (best case), **allowing multiple units to be inspected in one day** (flight itself is about **7-10 minutes**)



Flight route



Source : <https://e-e-power.co.jp/corporate/group/>



Photographic image



Image (enlarged)

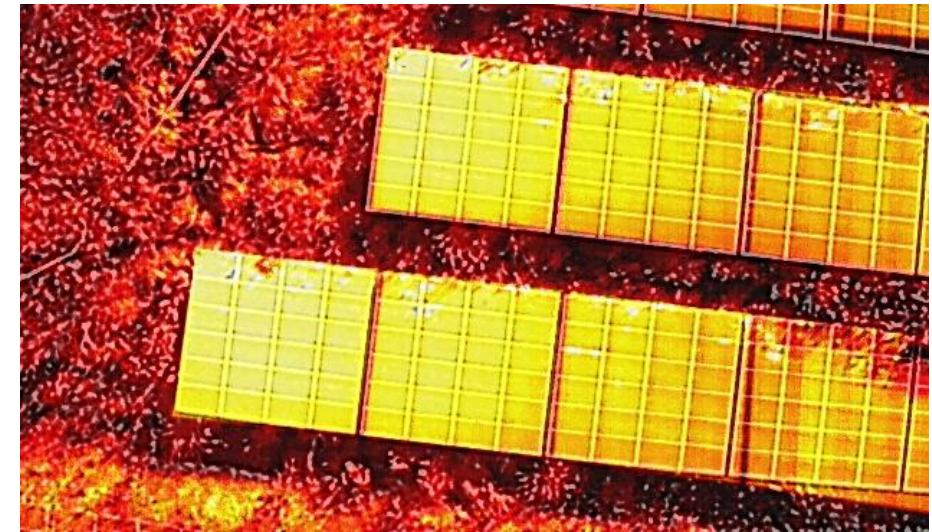
Photovoltaic panel inspection for one-stop solution proposals

ACSL

ACSL's compact "Mini" is mounted with a visible light and infrared camera, and acquires images by interval shooting. AI determines the location of defects.

Solar panel inspection

- **Launching a one-stop solution for solar panel inspection**, from drone photography to AI-based image diagnosis, in collaboration with **SkyLink Japan**
- Use of a **secure and reliable drone** (Mini) equipped with a flight controller originally, **domestically developed** by ACSL
- **Visible light and infrared image data captured by drones** are stored in the cloud, enabling **automatic detection of hot spots, etc.**
- They can be handled in chronological order so that changes over time can be observed, and can be easily **managed centrally** even in large facilities



Aerial photography using the high-resolution Phase One camera

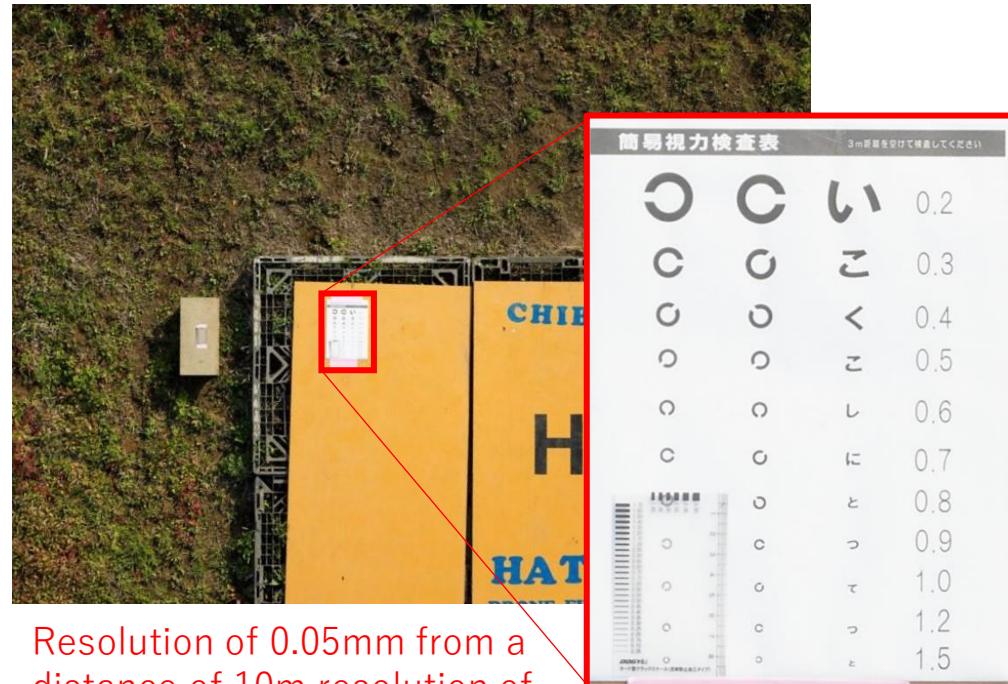
The PF2 is mounted with the Phase One iXM camera series, which enables high-resolution aerial photography of structures in explosion-proof areas, high-voltage transmission lines, wind power generators, and other difficult-to-access inspection targets

Infrastructure inspection using high-resolution aerial photography

- Ultra-high resolution camera with 150 and 100 million pixels for precise imaging
- It is possible to adjust exposure and control the shutter at any waypoint or interval from the ground, even while the drone is flying in automatic navigation
- Capable of acquiring high-resolution images with a wide dynamic range, ideal for three-dimensionalization and AI judgment



Sample images taken with the Phase One iXM-100MP (100 million pixels)



Resolution of 0.05mm from a distance of 10m resolution of visible lines



日本郵便の局間配達

ANA社の五島列島配達

**Drone delivery, a dream come true
Heading toward social
implementation**

Delivery

Remote control of a drone from Haneda to the Goto Islands, 1,050 km away, using unassisted non-visual flight (Level 3)

Operating even in strong north winds and rain, the realization of social implementation is almost at hand

Advanced delivery with Japan Post using Drones x UGV

ACSL

Continued to promote advanced delivery networks by combining Drones and UGV1 to conduct autonomous deliveries in rural areas



Collaboration between Drone and UGV

1: Unmanned ground vehicle

- ACSL entered **business partnership** with **Japan Post** and **Japan Post Capital** in Jun-21.
- Delivery trials having **drones and UGV collaboration** took place at Okutama, Tokyo in Dec-21.
- Concept is to **build an unmanned delivery model for rural mountainous areas**, through combining drones and UGV



Realizing social implementation of drone deliveries

ACSL

In sight of the de-regulation of Level 4 expected to take place in FY22, ACSL actively took part in drone delivery projects that tested practical service operations

Trials to do drone food delivery in central Tokyo

- First trial conducted at manned areas in Nov-21, together with **East Japan Railway Company** and **KDDI**.
- Scope also considered business model of drone deliveries after Corona



Trials of drone delivery service

Trials to do drone delivery service

- Immediate drone delivery service to 4 locations conducted in Nov-21 with **ANA HD** and **Seven Eleven Japan**.
- Scope considered **practical service implementation** such as delivery fees, Seven Eleven staff handling goods, take-off locations, etc.

ANA conducted a demonstration test of a delivery service to remote islands

ANA Holdings Conducts 20-day Demonstration Experiment of Goods Delivery Service in Goto City, Nagasaki Prefecture. Daily necessities were delivered from Fukue Island in response to orders from residents of Ki-Island and Aka-Island.



Inter-island delivery





離島での遠隔医療において
処方薬をドローンで配送

長崎県五島市

全画面表示を終了するには Esc キーを押してください

画質 自動 720p >

Establish a system for Emergency Response in Disaster Prevention and Disaster

Disaster prevention/disaster

Transporting emergency supplies to about 40 isolated households in Okutama

Establishment of emergency measures in response to the application of disaster laws and regulations



東峰村の災害調査



奥多摩での災害時輸送



Response to the mudslide disaster at Izusan, Atami City

ACSL

After the mudslide disaster that occurred in Atami City's Izuyama in July 2021, ACSL provided immediate support to assess the disaster situation, in line with the disaster prevention agreement with the Self-Defense Force.

ACSL's support system for the affected areas

- In recent years, **drones have begun to be used in disasters, but** there have been issues such as the inability to use drones immediately and the abandonment of purchasing drones due to the **burden of maintenance costs**.
- Signed an **agreement with the Ground Self-Defense Force's Eastern Area Command** in 2019 regarding support using drones in the event of a large-scale disaster.
- In 2020, ACSL will begin to support disaster **prevention and disaster-specification drones (ACSL-PF2) by providing them free of charge to disaster-stricken areas** in the event of an earthquake, typhoon, or other disaster.

Mudslide Disaster in Mt. Izu and the Use of Drones

- In July 2021, a mudslide occurred in Izuyama, Atami City, Shizuoka Prefecture, causing extensive damage downstream.
- **Based on an agreement with the Ground Self-Defense Force Eastern Army,** the ACSL flew drones to **assess damage after a disaster occurred.**



Preparing for flight at the site



2017年7月5日に発生した九州豪雨災害の直後に、
現地で消防と協力してドローンを飛行

Disaster Prevention Case Study - High-speed Aerial Photography (2D Orthoimage)

With a specialized quadruple-lens camera developed with Xacti, it is possible to capture 2cm resolution orthoimages with 80% overlap from an altitude of 100m while flying at a speed of 70km/h.



Survey of areas affected by the
torrential rain disaster



ACSL VFR Inc.

Continuous functional update to SOTEN based on customer demand

ACSL

Compatible with Pix4D software, which is used globally in aerial and disaster surveys, and LTE communication functionality also implemented

■ Compatible with leading global Pix4D software

- Integrated with Pix4D's software for creating high-precision 2D / 3D data. This enables more secure, high-definition data acquisition and data analysis
- PIX4Dmapper is used by professionals in Japan and abroad for a wide range of applications from surveying and construction to infrastructure mgmt
- PIX4Dreact has been installed in more than thousands of fire, police, and NPO

■ Implemented LTE communication support to enable flight in areas with no radio reception

- Enabled video and status monitoring using LTE network, making it possible to fly in areas with no signal coverage and to land safely using LTE communications in the event of a signal interruption

PIX4Dmapper



PIX4Dreact



Provided by Pix4D

Released aerial photography drone “SOTEN”

ACSL

Released aerial photography drone “SOTEN” and started to receive orders. Significant market reaction to the secure and reliable drone.

- 1 **Secure:** Data security, domestic and reliable components, encryption,etc.
- 2 **Usability:** One-touch interchangeable camera, clip-on propellers
- 3 **Flight performance:** Max 15m/s wind tolerance, SLAS/SBAS QZSS accuracy
- 4 **Peripherals:** Offline map, Secure LTE network, extension mounts



S O T E N



Released mass-produced delivery drone "AirTruck"

ACSL

"AirTruck," Japan's first mass-produced delivery drone which is designed to solve the manpower shortage problem in the logistics industry and to facilitate last mile delivery.

- 1 Stable flight:** 4D GRAVITY® center-of-gravity control technology to reduce cargo sway
- 2 High flight performance:** Aerodynamic optimization through aerodynamic simulation and wind tunnel testing
- 3 Remotely controllable:** Equipped with LTE communication, FPV camera, etc., suitable for Level 3 flight.
- 4 Improved load capacity:** Payload expanded to 5 kg
- 5 UX design:** easy-to-load from the top of the body



AirTruck

