X1 AERONAUTICS

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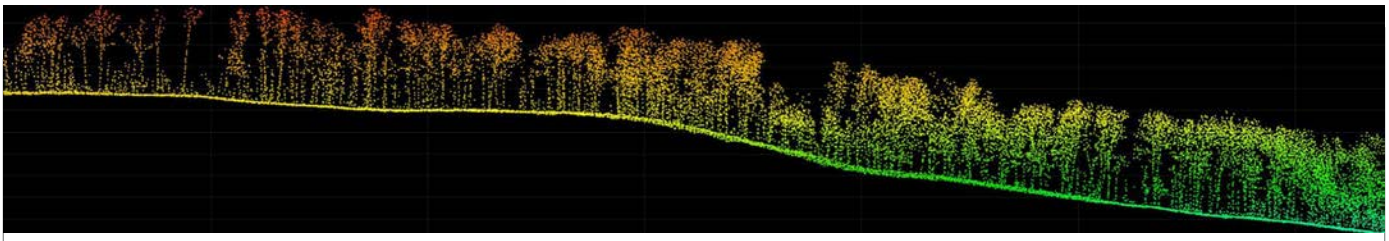
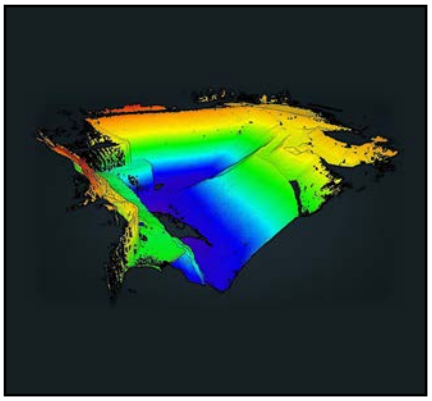
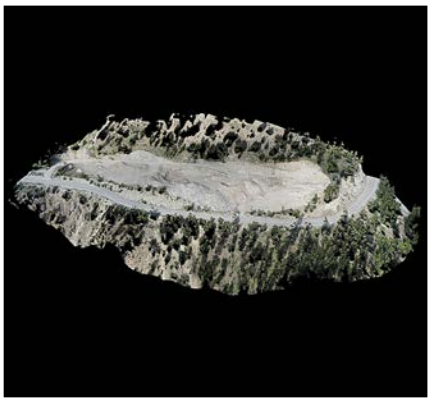
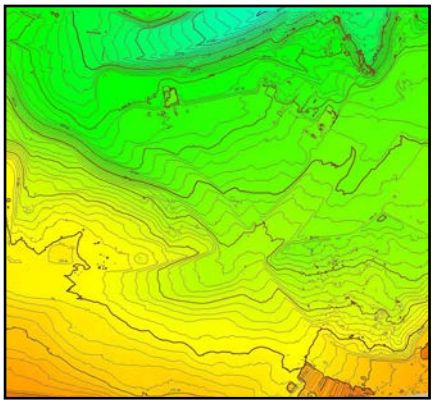


INNOVATION FOR INDUSTRY AND ENVIRONMENT







X1 Aeronautics provides advanced remote sensing and geospatial solutions to Canada's Natural Resources and Engineering sectors. Our advanced unmanned aerial vehicles (UAVs) and specialized software expedite the production of engineering-grade end-user products for a variety of industries including forestry, mining, oil and gas, engineering, and environmental management. With 30 years of experience, X1 has earned a reputation for being one of the top-ten most knowledgeable UAV experts in North America. Utilizing custom-engineered flight systems that meet the robust needs of industry ensures that projects result in increased accuracy and safety; providing our clients with more affordable, up-to-date information to maximize productivity. Increasing the quality of available information to our clients allows them to more accurately assess and manage resources, expediting cost-effective, fact-based decisions that optimize every facet of their operations.

Deliverables

Point Cloud
Digital Terrain Model (DTM)
Digital Surface Model (DSM)
Comparative Analysis
Oblique Aerial Imagery
Volumetric Calculations (stockpiles)
Volumetric Comparisons (cut/fill)
Contour Lines
3D Path Profiles
Bare Earth Model
Change Detection
Quarry/Landfill Surveys
Topography
Nadir Ortho Mosaic
Oblique Ortho Mosaic
Cross Sections
Slope Analysis
Vegetation Mapping
Flood Simulation
Triangulated Irregular Network
Heat Mapping
Canopy Heigh Model
Watershed Analysis

PRODUCTS AND SERVICES

Benefits of UAV Surveys

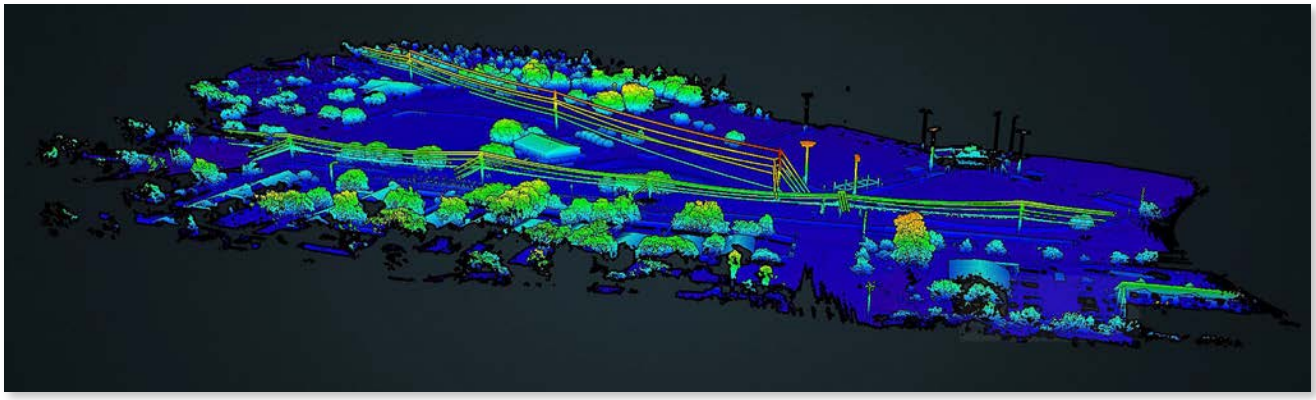
INCREASE: Safety, Efficiency, Profitability, Accuracy
REDUCE: Environmental Disturbance, Project Timelines, Financial Risk, Overall Costs
IMPROVE: Productivity, Data Quality, Revenue Opportunities, Decision Making
INNOVATE: Multiple Applications - 1 Flight, Up-to-Date Information, High Density
GAIN: A Competitive Advantage

Applications

Oil and Gas
Environmental Management
Utilities and Transportation
Forestry
Engineering
Mining

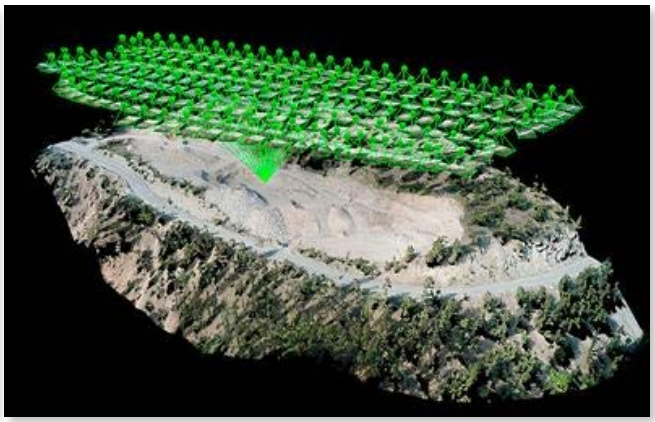
Services

Growth surveys
Reclamation
Environment assessments
Silviculture surveys
Mine design survey
Life cycle planning
Tailings pond initial site survey
Tailings pond survey
Area inspection survey
Wildfire monitoring
Volumetric calculations
Stability monitoring
Change detection
Asset & liability monitoring
Disaster/risk evaluation & mitigation
Forest inventory mapping
Timber inventory mapping
Free growing survey
Vegetation/revegetation mapping
Drainage & watershed analysis
Bridge inspection
Transportation & utility surveys
Wildfire fuel mapping
Harvest planning
Forest canopy mapping
Channel feature mapping
Land use mapping
Hazard mapping
Heat mapping
Industrial inspection
Pre/post blasting data
Open pit mine survey
Dam survey
Flood mapping
Pit & dump survey
Pipeline monitoring
Resource management
Terrain mapping
Site assessment/planning
Slope analysis
Cut & fill calculations
Erosion detection
Spill detection



STRUCTURE FROM MOTION PHOTOGRAMMETRY (SfM)

Structure from Motion (SfM) photogrammetry relies on a highly redundant data set of multiple overlapping images for a dense matching of points. Recent advancements in UAV technology allow us to increase our point cloud density from 200 – 300 points per square meter to up to 1100 points per square meter in average lighting conditions. Flight plans are carefully created prior to arriving on site to reduce field time and are saved in order to expedite projects requiring frequent monitoring. Rapid long-distance data acquisition offers an increase in safety by eliminating the need for a ground crew to traverse dangerous terrain and allows our experienced field crew to work outside the perimeters of project activity. Following every flight, a quality check is completed to assure we meet or exceed project requirements and is available to clients upon request. File sizes can easily be reduced to accommodate client needs.



Benefits of SfM Photogrammetry

High relative and absolute accuracy	Accuracy levels average 2.5cm, set prior to flight to accommodate the scope of the project. Ground control points used where appropriate, depending on requested accuracy levels
Rapid acquisition and processing	Pre-programmed flight plans are saved and reutilized for repeat surveys of rapidly evolving projects. Up to 100ha scanned per hour. Up to 50 minute flight times
Improved data acquisition and management	24-megapixel commercial-grade camera system with a large sensor integrated processing of orthoimagery. Seamless integration with CAD, GIS and other mapping software
Instant high-density point cloud generation	Extremely dense point clouds of 60 -1100 points per square metre. Colourized to improve visualization
Cost	Dramatically reduced over the cost of traditional airborne or ground surveys

LiDAR

Light Detection And Ranging (LiDAR) is a method of remote sensing that uses pulses of light beams from a laser to measure distances between the sensor and features on the earth. Combined with a powerful GPS, LiDAR delivers unmatched accuracy in acquiring height and location data of features. Both natural and built environments can be precisely mapped with our LiDAR systems including such features as vegetation canopies and understory, mining tailings ponds, pipelines, and many more. **Example of Flight Real Time Quality Control Go To:**

https://www.youtube.com/watch?v=juPFCd9kYrs

Benefits of UAV LiDAR

High relative and absolute accuracy	Position error of 3.8cm Integrated RTK base station means no need for GCP targets • Ideal for mapping previously inaccessible, featureless, or hostile environments
Rapid acquisition and processing	Up to 200ha covered in a single flight Up to 45 minute flight times with maximum payload • Extended flight durations result in increased safety and expedited project completion times • Competitors are currently limited to 12-14 minute flight times
Canopy Penetration	Multiple returns for classification of canopy and understory
Improved data management	Multiple scans can be easily merged without loss of accuracy or data Integrated geo-referenced orthoimagery. Many processes are automatic, requiring fewer human interactions and involvement
Instant high-density point cloud generation	50-1900 points per metre Scan rate of 300k shots/second, up to 600k points/second Real-time monitoring of point cloud at ground station
Independence from weather and lighting conditions	Data collection independent of sun inclination and position. Can be flown under clouds and unaffected by shadows. Capable of safe project completion in winds up to 30km/hr and temperatures ranging from -15ºC to 50ºC
Cost	Significantly cheaper in many applications than traditional survey methods • Especially notable when considering speed, accuracy, and density of the data collected

LiDAR SYSTEMS

LiDAR UAV System - 1300X8mr

X1 Aeronautics 1300X8mr is the safest and most reliable system available for commercial use in North America. X1 Aeronautics's custom designed aircraft are engineered to outperform those previously available, providing a superior alternative to expensive land survey crews, full-scale aircraft and satellites.

Safety Features:

- Low voltage auto return to land
- Dual gyroscope
- Dual magnometer
- Triple 6-axis accelerometer
- Triple redundant power supply
- Redundant drive systems
- Auto fail-safe return to home on lost radio link
- EKF vibration and monitoring at ground station
- Dual parachutes
  - Deployed manually
  - Programmed emergency response from autopilot

LiDAR - AL3-16 Mobile System

Data Acquisition

X1's vehicle-mounted mobile AL3-16 LiDAR system provides a convenient alternative to our airborne LiDAR system, delivering precise survey data for highway mapping, roadside engineering and urban planning projects.

Our mobile LIDAR solution overcomes the challenges of mapping linear features, while operating from a vehicle greatly increases the safety of personnel and minimizes land and road closures; this provides a significant reduction in data acquisition time in the field and traffic management costs.

Benefits of Mobile LiDAR

- Collects detailed asset and engineering information
- Compact, lightweight, and transportable
- Fast and easy to mount
- Significantly reduces time in the field compared to traditional survey techniques
- Minimizes lane and road closures
- Eliminates or reduces traffic management costs
- Increases safety of personnel by avoiding exposure to fast moving traffic
- Faster than conventional methods of data acquisition

TEAM PROFILES

SHAUN BELL - Founder/CTO, UAV Operator & Designer, Data Processor

Responsible for the development of our advanced fleet. It has been said that Shaun is among the top five UAV experts in North America. His extensive knowledge and in UAV flight systems and field operations has earned X1 the respect of government agencies, educational institutions and industry throughout Canada. Shaun's vast expertise includes, but is nowhere near limited to:

- SUAS design, fabrication, and piloting
- Post processing of remotely sensed data
- Supersonic principles of aerodynamics
- Solid & liquid fuel systems
- High altitude telemetry
- Electronic design & execution
- GPS systems
- Speed control software and design
- Motor redundancy
- Motor and propellor efficiency
- Vibration analysis safety protocol
- Airframe optimization

SUSAN FREEMAN - Founder/CEO, Business Operations, Field Operations

Sue is credited with X1 Aeronautics' long-term vision for Canada's Natural Resource management and liability monitoring. Sue is responsible for business operations and development while meeting demands for ever-increasing efficient environmental and sustainable solutions. With a keen understanding of the current UAV technology, she accurately forecasts industry specific needs. Her visionary leadership and strategic direction have prepared X1 Aeronautics for its current UAV leadership role within Canada.

FRASER ABDALLAH - Geomatic Engineering Technologist

Fraser is a Geomatic Engineering Technologist graduate from SAIT Polytechnic and a valuable member of the X1 team who consistently delivers innovative and practical solutions that exceed client expectations. His extensive experience conducting field ground survey work transfers seamlessly to X1's field operations, creating a well-organized field experience. Fraser has contributed many skills to our team including expertise in remote sensing, GIS, photogrammetry, LiDAR and 3D modelling. Previous experience: Universal Civil Management - Surveyor, Align Surveys Ltd. - Survey Assistant/Party Chief, McElhanney Land Surveys Ltd - Surveyor Assistant

JORDAN STEINGASS, HBSc - Project Manager

Jordan is a graduate student in Natural Resources Management (MScF) at Lakehead University in Thunder Bay, Ontario. Her research focuses on mapping invasive plant species using infrared UAV imagery in Grasslands National Park. She has a commercial pilot's license with extensive experience coordinating flight operations, making her a valuable resource in the implementation of UAV operations. Jordan's background in geography and geology, with a focus on GIS and mapping, provides a well-rounded knowledge base of many natural resource sectors including forestry and mining.

TEAM PROFILES

FRASER CAMPBELL - Business Advisor

Fraser Campbell is an Executive in Residence at Accelerate Okanagan. He is a serial entrepreneur who has participated in several startups, rollouts, mergers and acquisitions over the last 25 years, with his partners in First Growth Management. He has been involved in corporate structure, strategic planning, change management, and business systems across Canada and the US within several service industries such as warehousing, aviation, construction, oil and gas, and defense and public security.

Testimonials

“Collaborating with X1 Aeronautics in different research and student design projects has been a great learning experience for me and my students. We have benefited from Shaun's extensive knowledge and field experience in our drone development and testing projects. X1 Aeronautics is a company that I would rely on in our work on aerial mapping and other drone-related R&D projects”.

- Dr. Homayoun Najjaran, PhD, PEng, University of British Columbia, Faculty of Applied Science, School of Engineering

“The X1 Aeronautics team is extremely knowledgeable in the field of UAVs and remote sensing. Mr. Shaun Bell (CTO) of X1, custom fabricated the 960mm X8 UAV to our specifications, which he personally delivered. He also provided an in-person educational program, including two days in the classroom which focused on assembly and software programming, followed by one day in the field flight training. This session helped to ensure our group gained the required knowledge and skills to effectively make the most of this technology. It was very clear from this session that Shaun is an expert in this field and has very extensive knowledge of UAV system operations. He was able to answer all our questions in such a manner that we could clearly understand and has been available for further questions and technical support post training. The X1 team has helped to ensure our group is on the right track to meet all of Transport Canada's UAV flight regulations. X1 Aeronautics’ quality of service and professionalism is beyond exceptional. If your company or organization is seeking a UAV system or remote sensing services, we strongly recommend speaking to Shaun and his team. They will be sure to offer you the best advice and options for your organization’s needs”.

- Carmen McConnell
Senior Technician, Fisheries and Oceans Canada
- Ron Goruk
Biologist, Fisheries and Oceans Canada
- Kirby Rietze
Engineer, Fisheries and Oceans Canada