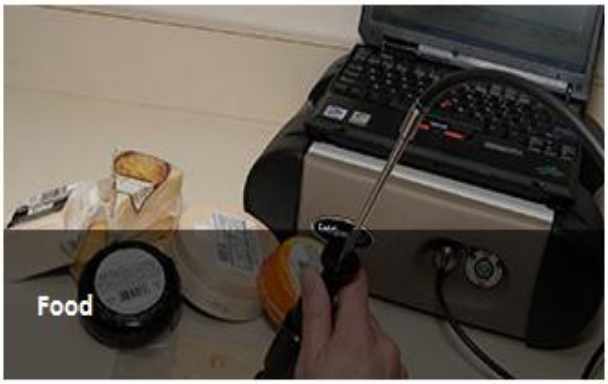
ASD Field Spec-4

Application Solutions

Application -1

Materials Analysis

Near-infrared analysis is used for a variety of materials analysis needs, from raw material identification to quantitative measurement of composition. ASD systems are used with library search techniques to qualitatively identify materials. This technique is useful for validation of raw material to assure the correct material has been received. ASD systems are also used with multivariate discriminant models to qualitatively compare a new sample to a model representing the expected diversity of this material. This technique is used to answer the question "Is it the same as previous samples." Finally, ASD systems are used with multivariate quantitative models that can be used to predict the concentration of certain analytes such as moisture content. This is helpful for quantitative material analysis.



- ✓ **Quality Control and Raw Material Analysis**

  Ensuring the quality of incoming raw materials is a critical first step in most industrial processes. Identification of non-conforming materials can improve operational performance and save valuable time. Quality control is at least equally important during the manufacturing process to produce better quality products and to increase profitability. Near-infrared (NIR) spectroscopy is an easy-to-use measurement tool for rapid, non-destructive, material inspection. NIR spectroscopy can determine both the identity and purity of raw materials and allows for non-destructive sampling and material analysis (sometimes even directly through plastic bags) thereby eliminating the need for messy and time consuming sampling and sample prep associated with many traditional analytical laboratory methods. Results can be measured in seconds allowing for a more efficient assessment of raw materials to enable more timely decisions.

  - No sample prep
  - Real-time results
  - In situ measurements
  - At-line measurements

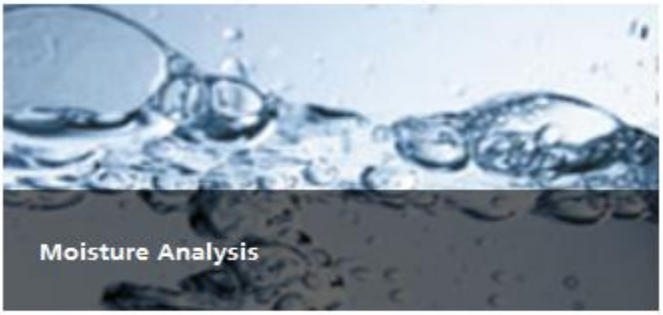
  The LabSpec laboratory analyzer in the goLab Mobile Work Station in use for raw material inspection on a loading dock.

  ASD provides rugged, truly-portable, research-grade instruments, accessories, and software for real-time, on-the-spot material inspection through final product. ASD's measurement solutions allow manufacturers to implement cost-effective 100% incoming material inspection where and when it's needed—in the field, on the receiving dock, in the warehouse and production facilities, or just about anywhere else you can imagine.

  Optimize your material inspection process with ASD technology and:

  - Decrease out-of-spec product and waste
  - Improve product quality and yield
  - Boost your bottom line

  Raw material analysis is ideal for a variety of industries. Explore the applications below, ideally suited for ASD's instruments, software and service solutions.



- ✓ **Food Analysis and Protein Analysis**

Changing standards for producers and manufacturers to verify, the quality and safety of food, beverage and dairy products demands the testing of food throughout the supply chain. From the farm to the table, never has the need for economical testing been so urgent. ASD's systems can be used to increase the frequency of testing or the number of testing points during production processes without requiring the use of cost prohibitive laboratory techniques.

NIR spectroscopy is a proven and accepted method of food analysis and is used to monitor product quality parameters within the food, beverage, and dairy industries and offers significant advantages:

- Real-time analysis
- Measure multiple constituents simultaneously
- Non-destructive testing
- No sample prep
- No chemical waste stream, environmentally friendly
- Less sample waste

Decrease operation costs, increase yield!

ASD's portable, benchtop and online Vis/NIR food analysis instrumentation provides the flexibility to measure where and when it is most advantageous to you. Gone are the days of collecting samples, sending them to a laboratory, and waiting for the results. ASD's Vis/NIR measurement technology offers the cost effective solution you need to:

Easily analyze product on the production floor or manufacturing facilities, on the receiving dock, in the warehouse, in many cases even through glass and clear plastic bags and bottles

- Monitor in-process and finished product to ensure quality and consistency
- Minimize risk of product and/or material waste

Vis/NIR spectroscopy has been successfully used in the production of cheese, meat and meat products, fish, egg products, milk, butter, beer, wine, fruit juices, baked goods, cereal, produce, jams, jellies, nutritional supplements and more. Some of the more common applications include measuring:

- Fat levels
- Protein content
- Moisture content
- Oil content
- Sugar content
- Starch content
- Blend uniformity analysis

Food scientists are also utilizing Vis/NIR spectroscopy to develop specific ingredients to enhance the nutritional quality of foods and beverages. With an ASD NIR food analyzer, you can generate increased information for tighter production controls, decreased off-spec product, better overall product quality, and a boost to your bottom line!

✓ Natural Products and Dietary Supplements

Food and Drug Administration (FDA) cGMP standards require inspection of nutraceutical product ingredients and dietary supplement ingredients to ensure that the correct materials are used and to standardize ingredients to ensure product consistency. These measures call for 100% lot testing of raw materials and final product. NIR analysis is used widely throughout the pharmaceutical industry and is recognized for material testing and identification by the FDA and United States Pharmacopeia (USP)

ASD's portable and bench top measurement solutions offer cost-effective means for not only quality control throughout the manufacturing process, but also at-line analysis, inspection of incoming raw materials. ASD analyzers and software meet compliance requirements set under 21 CFR Part 11, and guidelines for USP 1119, by providing a technology platform for validatable, qualitative and quantitative test procedures.

Cost Saving Solution

- Easily verify incoming materials, even through clear glass and clear plastic bags and bottles
- Quickly identify inferior or counterfeit ingredients before they enter your production process
- Monitor in-process and finished product to ensure quality and consistency
- Minimize the risk of out-of-spec product

ASD offers Nutraceutical Analysis Packages with a wide array of probes enabling streamlined testing of powders, leaves, roots, pellets, solids, liquids, and other raw materials quickly — at

the dock, on the manufacturing floor, or wherever it is needed. With ASD systems, you gain the power to confidently and rapidly test your product and raw materials, non-destructively, and without the sample prep, delay, and expense associated with traditional laboratory methods.

Comprehensive analysis — simultaneously analyze multiple constituents, store data, and easily retrieve calibrations associated with each application. Seamlessly interface with Grams™ IQ chemometrics software for applications requiring qualification and quantification.

Our visible region spectral coverage allows you to utilize color analysis not covered by many other NIR systems.

- Fast System Set-Up

Get your facility operational quickly and cost effectively with ASD:

- Large starter library available and easily expanded with components tailored to your product line
- Installation assistance and program training tailored specifically for nutraceutical analysis

✓ Near Infrared Spectroscopy Applications in Pharmaceutical Analysis

When you require rapid, accurate measurement of pharmaceutical products, look no further than ASD's complete line of Vis/NIR spectrometers.

- Rapid measurement of samples—typically within a few seconds
- Non-destructive measurement of samples at various points in the production process

- Ability to measure multiple constituents simultaneously
- Little or no sample preparation
- Flexible configurations from an array of sampling accessories
- Versatility of working in the plant or in the lab
- Cost effective

Vis/NIR is a widely accepted technology for monitoring and measuring raw materials, product content in-process, and the constituents of finished products. Through every step of the operation, implementation of ASD instrumentation meets standard international Current Good Manufacturing Practices (cGMP) and can help ensure that your product components meet regulatory requirements. Our instrumentation has been effectively deployed in pharmaceutical processing and pharmaceutical inspection, including counterfeit detection.

The LabSpec® line of portable spectrometers allows you to measure materials where and whenever necessary, this eliminates the need to collect samples and transport them to the lab. The LabSpec laboratory instruments can be used in the warehouse for inspection of incoming raw materials or on the production floor to verify product compliance. For work in the lab, the LabSpec 4 Bench instrument provides rapid measurement of the highest accuracy. All ASD instruments have a wide spectral range of 350 to 2500 nm, which allows them to measure the active pharmaceutical ingredient (API) as well as excipients such as binders and colorants simultaneously. This versatility ensures complete coverage of your product and makes ASD systems a cost-effective choice for pharmaceutical analysis, especially when compared with more limited, single-item measurement options. All ASD spectrometers are available with a wide array of sampling accessories, to customize the instruments to fit your needs.

ASD pharmaceutical measurement products come with the documentation to incorporate them into your facility, including IQ/OQ/PQ. To help you fully integrate the devices into your system, ASD offers installation and setup services for the LabSpec lab analyzers. We also offer ongoing service and maintenance plans to maximize the benefit of your investment.

Application 2

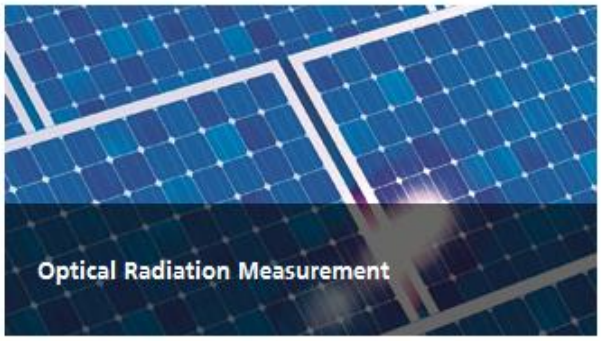
Defense & Intel

ASD's FieldSpec 4 line of spectroradiometers is a critical tool for measurement and signature intelligence (MASINT). Accurate MASINT provides a strategic advantage in the planning of military operations and deployments. The successful exploitation of hyperspectral and multispectral imaging sensors depends on the availability of accurate and complete spectral signature libraries. Coupled with the appropriate spectral signature library, images collected with these imaging sensors provide the means to survey large areas identifying and characterizing materials, detecting a wide range of camouflaged targets, and detecting disturbed surfaces. Applications include remote evaluation of trafficability; shallow water bathymetry; and, camouflage characterization and detection

Application 3

Optics and Photonics Applications Using Vis/NIR/SWIR Spectroradiometers

In optics and photonics applications, determine light source characteristics through radiant energy measurements with ASD's rapid, precise spectroradiometers. Our highly sensitive, mobile Vis/NIR/SWIR instruments measure laser power, characterize solar simulators, spectral lamp flux, and critical measurements of laser diodes and LEDs such as optical power, color, and goniometric measurements. R&D, production and quality assurance teams benefit from flexible measurement integration, superior sensitivity and rapid data collection.



Application -4

Agriculture

For decades, scientists have used high-resolution reflectance spectra of minerals and soils to determine soil mineralogy, and to assess soil physical properties. A major breakthrough in these studies has been the use of visible-near infrared spectroscopy to develop quantitative calibrations for rapid characterization of soil nutrients and various physical properties of soils. The coupling of this technology with remote sensing data, georeferenced ground surveys, and new spatial statistical methods has resulted in the improved capability for large area soil assessments. Rapid spectroscopic soil analysis breaks the bottleneck of sample collection and lab testing, and permits the assessment of soil quality on a large number of representative samples covering expansive geographic areas.

Expansive spectral libraries continue to be developed for the interpretation and application of spectra to soils analysis. The spectral library approach allows calibrations based on small numbers of selected samples to be applied to the rapid analysis of thousands of samples. These studies overlap into many practical applications, including hazardous waste and environmental applications, agricultural analysis, hydrology, and soil fertility assessment.

Plant physiology-related applications include the analysis of plant tissue to assess water, nutrient and disease status. These applications are based on both canopy-level and leaf-level measurements of reflectance. Vegetative indices and the same type of quantitative modeling techniques used to develop soil nutrient calibrations have been used by researchers for determination of a wide range of plant biochemicals, including chlorophyll, xanthophylls (and other pigments), lignin, cellulose, and total nitrogen content (as related to protein concentration). In addition to analysis of photosynthetic biomass, these methods have also been applied to rapid analysis of seed composition for crops such as corn, wheat, rice, soybeans, and canola.

Crop photosynthetic modeling is another application in which ASD systems excel. These studies require the measurement of photosynthetic radiation above, below, and within a crop canopy. By measuring spectral irradiance, rather than just a single integrated reading, researchers can better study the interplay of the various secondary pigments.

The ability to accurately perform reflectance and radiometric measurements of vegetation and soil in the field is critical to all of these applications. The ASD FieldSpec® line of spectroradiometers offers a wide range of configuration options for both contact measurements (such as leaves or in a soil profile pit) and stand-off measurements (such as those needed to measure canopy reflectance). The FieldSpec uses a flexible fiber optic cable that can be used with many different accessories and configurations, giving researchers many options for acquiring critical data. ASD systems provide unmatched portability and spectral quality to allow researchers to work in some of the most remote regions of the planet while producing excellent spectral data..

Plant breeding researchers and genetics companies utilize ASD systems to allow characterization of new varieties and for production of the best quality seed. Our wide variety of sample probes allows the measurement of natural products without the need to grind or otherwise destroy the sample. Agriculture applications demand high throughput and low cost analyses. ASD systems typically can measure natural materials in as little as 5 seconds with no consumables and no sample preparation expense. Crops and animal feeds are also typical applications for ASD systems.

Scientists around the world use ASD instruments in their soils and crops research. Learn more by visiting one of the sections linked below.

Application -5

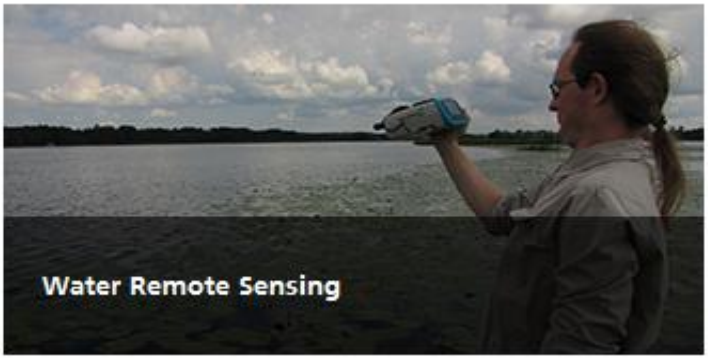
Environmental

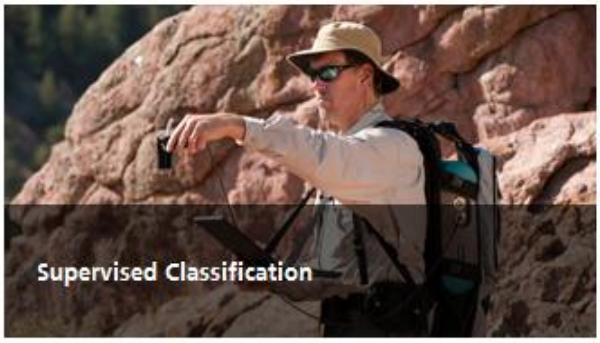
ASD instruments, software and solutions are ideal for a variety of environmental-based applications. These instruments, software and solutions provide valuable insights into environmental applications such as ice, water and snow research, climate effects and landscape ecology.

Application – 6

Image Classification/Analysis

Remote Sensing image classification and analysis techniques utilize both spatial and spectral information in an image to derive patterns and to extract as much information as is possible from an image. Almost all forms of image classification and analysis benefit from the availability of a spectral library that includes entries for all materials that contribute significantly to the mixed spectral signatures observed in the imagery. ASD's FieldSpec 4 line of spectroradiometers are the ideal tool for building a spectral library since field collected reflectance spectra most accurately portray the view from a satellite or aircraft imaging sensor. This is especially true for materials such as vegetation whose spectral signatures are determined both by the optical characteristics of individual elements as well as the three dimensional arrangement of those elements. The ability of ASD's FieldSpec 4 spectroradiometers to rapidly collect accurate field spectra make them the ideal tool for performing these critical field measurements.



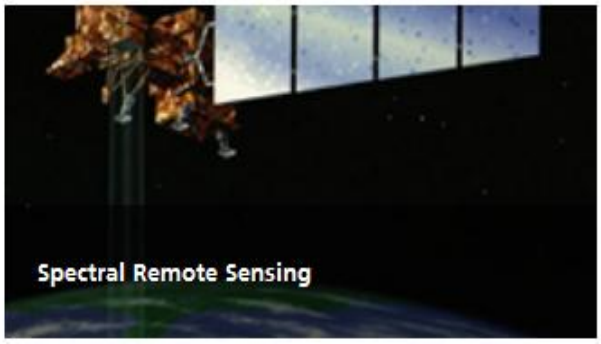

Supervised Classification


Airborne Remote Sensing Measurements


Field Spectroscopy


Ground Truthing

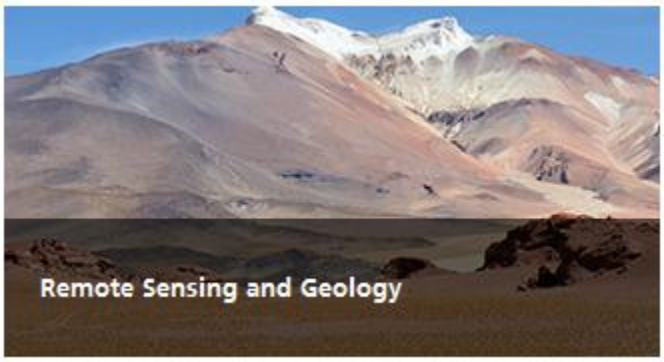

Sensor Calibration


Spectral Remote Sensing

Application – 7

Geology/Mining

ASD's mineral analyzers and identifiers, coupled with software and support solutions, provide the mineral analyses needed for many mining, petroleum, geothermal and industrial mineral applications.



1. Soil Analysis for Agriculture and Soils

Precision In-Situ Soils Analysis

Diffuse reflectantance spectroscopy has long been a core technology of soil characterization studies. Today, with the growth and availability of soil spectral libraries from around the world and countless labs developing custom quantitative calibration models for the interpretation and application of spectra to soils analysis, rapid and accurate in-situ soils characterization has become a reality. Quantitative models allow calibrations based on as few as 100 selected characterized samples to be applied to the rapid analysis of thousands of samples, in the field or in the lab. Coupling this technology with hyperspectral imagery, ground truthing, and advanced spatial statistical methodologies has resulted in a greatly improved capacity for wide area soil assessments.

Break the Laboratory Dependency

Maximize your resources, save time and money, and realize the strategic value of rapid on-site analysis. Field portable near-infrared (NIR) spectroscopy with quantitative calibration models breaks the bottleneck of sample collection for lab-based testing, minimizing lab-related project costs, while providing analysis results to the field survey work-flow.

Applications

- Soil mineralogy
  - Review our 2013 ASA, CSSA, & SSSA annual meeting poster "Measurement of Soil Mineralogy and CEC Using Near-Infrared Reflectance Spectroscopy"
  - Review our 2011 ASA, CSSA, & SSSA annual meeting poster "Measurement of Soil Mineralogy and Total Carbon Using Near-Infrared Reflectance Spectroscopy"

    - Best practices for obtaining and processing field visible and near infrared (VNIR) spectra of topsoils, Jean-Philippe Grasa, Bernard G. Barthèsa, Brigitte Mahautb, Séverine Trupinb, 2014
- Soil organic carbon (SOC)
    - Review our application note "Analysis of Soil Organic Carbon in Soil Samples using an ASD NIR Spectrometer"
    - Rapid Carbon Assessment (RaCA) Methodology, Sampling and Initial Summary, USDA, 2013
    - Rapid Assessment of U.S. Soil Carbon (RaCA) for Climate Change and Conservation Planning, Summary of Soil Carbon Stocks for the Conterminous United States, USDA, 2013
- Crop management

World Agroforestry Centre Studies

The World Agroforestry Centre, with support from the Rockefeller Foundation, has produced a remarkable set of breakthroughs in tools for rapid large area assessment of soil quality and organic resource quality using the FieldSpec Vis/NIR full-range spectrometer (Shepherd & Walsh, 2002). The characteristics of soil spectra are controlled by mineral composition, organic matter, water (hydration, hygroscopic, and free pore water), iron form and amount, salinity, and particle size distribution. These attributes of soil basically determine their capacity to perform production and environmental functions. Calibration techniques, based on new pattern recognition algorithms, have been developed so that multiple soil attributes can be assessed from this single measurement (Shepherd & Walsh, 2002). Soil functional attributes such as aggregate stability, soil infiltration rate, and soil respiration rate can also be related to soil reflectance in a number of studies.

- Soil condition classification using infrared spectroscopy: A proposition for assessment of soil condition along a tropical forest-cropland chronosequence, 2007. Awiti, Walsh, Shepherd, Kinyamario
- Prediction of carbon mineralization rates from different soil physical fractions using diffuse reflectance spectroscopy, 2005. Mutuo, Shepherd, Albrecht, Cadisch
- Sensing landscape level change in soil fertility following deforestation and conversion in the highlands of Madagascar using Vis-NIR spectroscopy, 2005. Vagen, Shepherd, Walsh
- Unravelling the effects of soil and crop management on maize productivity in smallholder agricultural systems of western Kenya—An application of classification and regression tree analysis, 2007. Tittonell, Shepherd, Vanlauwe, Giller
- Global soil characterization with VNIR diffuse reflectance spectroscopy, 2005. Brown, Shepherd, Walsh, Mays, Reinsch