

DELIVERING BREAKTHROUGH SOLUTIONS

Developing & Transitioning Cutting-Edge Technologies

Since its inception in 1987, CFD Research Corporation has developed cutting edge technologies and provided breakthrough solutions and expert services for government agencies, businesses, and academia. CFDRC has earned national recognition for successful application and commercialization of innovation technologies.



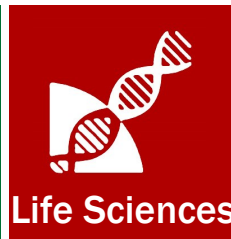
Aerospace



Propulsion



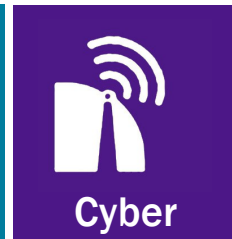
Energy



Life Sciences



Materials



Cyber

Visit www.cfdrc.com for more information

Capabilities

Coupled Physics—Based Simulation

- Multi-physics, Multi-scale, Multi-fidelity simulations of fluid, thermal, chemical, mechanical, electrical and biological phenomena.

Design, Fabrication, Test and Evaluation

- Customized capabilities to create and demonstrate next-generation technologies.

Expert Support Services

- Subject matter expertise including independent development and evaluation of technologies and concepts.

Our Impact



CFDRC has transitioned
20 Technologies
into the market and spun-out
2 Companies



We have been awarded
66 Patents
and have
Out-Licensed **25**
with royalties



We have worked on
1400 Contracts
and currently
Working **80**

About CFDRC

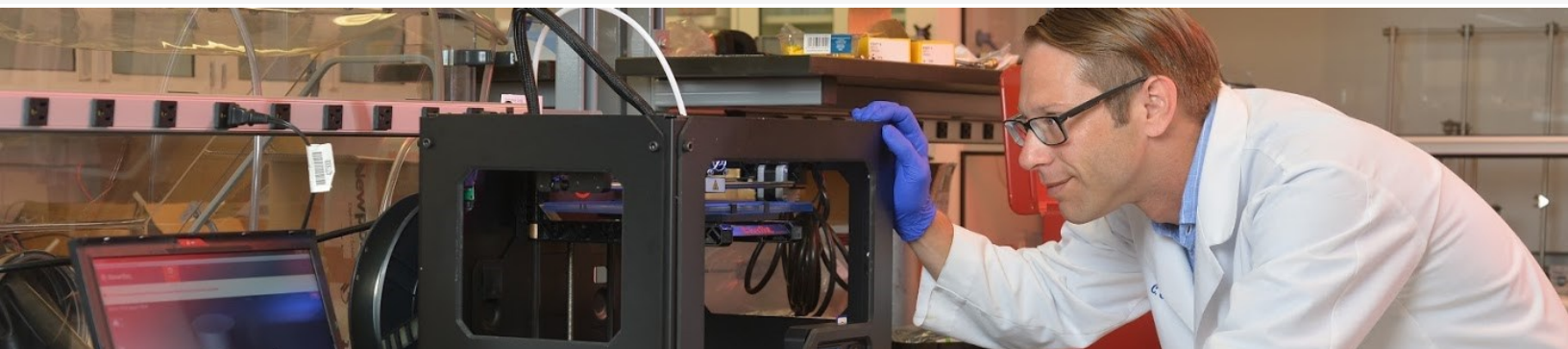
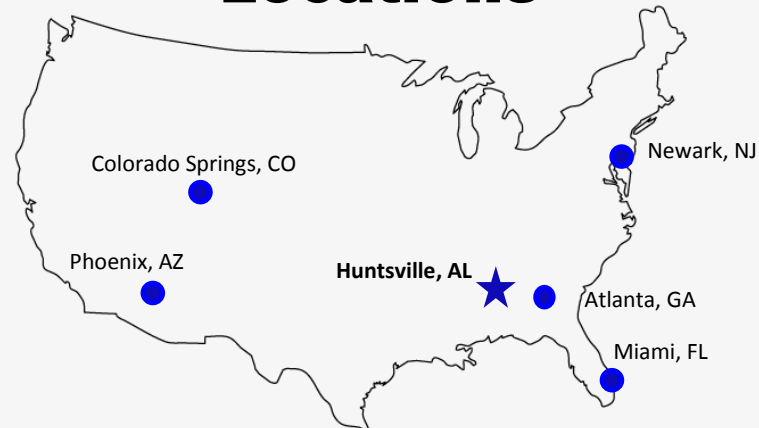
Mission

Develop cutting-edge technologies and deliver high value solutions for government and industry.

Vision

Transforming the world with technology solutions created by our employees and partners.

Locations



Solution Oriented

We are committed to deliver creative solutions to important and challenging problems.



Fun

We value fun and enthusiastically celebrate personal and customer success.



Accountability

We value accountability to ourselves, our team members, colleagues, and customers.



Collaboration

We leverage our resources and network to provide timely, cost effective, and targeted solutions with our customers.



Respect for Others

We value a work environment that fosters respect for others and rewards open-minded communication.



Passion

We believe that passion is critical for creative, high-value solutions. We seek and reward self-motivated individuals.



Proven Track Record



**Highly Qualified Team
(>35 PhDs)**



Employee Owned

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Aerospace

Applications

CFDRC couples advanced multi-physics modeling and simulation technologies with unique test and evaluation methods to develop innovative products and deliver breakthrough aerospace and defense solutions to commercial and government customers.



Aircraft

Physics-based modeling tools and engineering services to analyze aerodynamic performance, loads and structures, stability and controls.



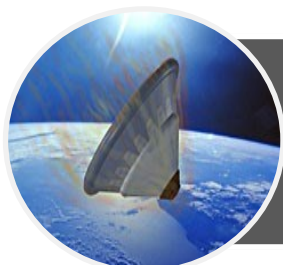
Rotorcraft

Simulation technology and engineering services to support rotorcraft specific applications including engine dust, aerodynamics and noise.



Launch Vehicles

Applications include lift-off acoustics and ignition over-pressure, stage separation, debris analysis and mitigation, and fuel sloshing dynamics.



Space Vehicles

Application areas include reentry aerothermodynamics, inflatable aerodynamic decelerator design, and materials characterization.



Weapon Systems

Application areas include aerodynamic performance, divert and attitude control, plume signatures, propulsion and combustion systems, etc.

Visit www.cfdrc.com for more information

Examples

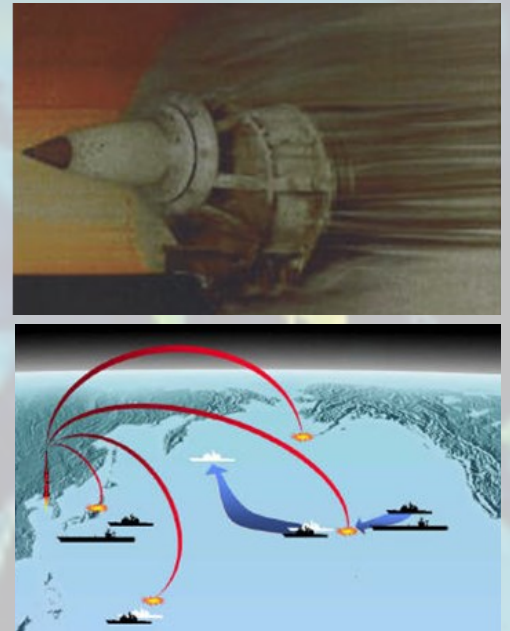
Missile Weather Toolkit

Improving Design and Operation of Missile Systems

The Missile-Weather Toolkit (MWeT) characterizes high speed flight survivability relative to adverse weather conditions along a flight path.

The ultimate goal is to give missile programs the tools to more accurately and efficiently design and optimize missile survivability in realistic weather environments and integrate the impact of weather in operations to increase the potential for mission success.

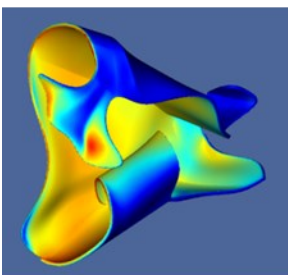
Through the application of historical, real-time, or forecast weather information, MWeT helps users better understand the requirements to design, develop, and test a high speed flight system. Test advantages include the correlation of realistic flight environments to ground test conditions, and the development of weather launch criteria for flight tests.



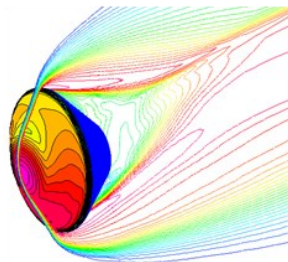
Unified Flow Solver

The Next Generation of Computational Tools

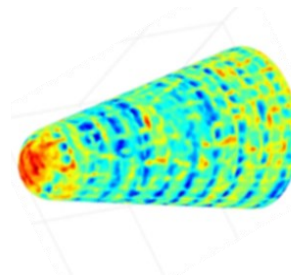
The Unified Flow Solver (UFS) allows simulations of rarefied, transitional and continuum flows based on direct numerical solution of the Boltzmann equation coupled to kinetic schemes of gas dynamics.



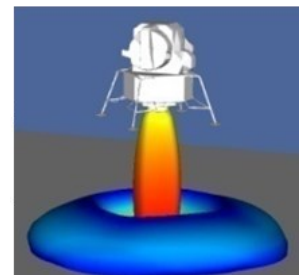
High altitude
post-intercept
debris aerodynamics



Coupled endo,
transitional, and exo-
atmospheric analysis



Coupled CFD and
computational
electromagnetics



In-space propulsion
and planetary lander
plume-surface

Propulsion

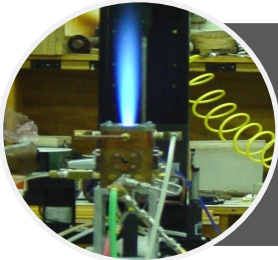
Applications

CFDRC is pioneering innovative technologies for propulsion solutions by designing better propulsion systems, developing improved fuels and energetics, and applying propulsion technologies in new ways to solve technical challenges.



Combustion Systems

Prototype design, development, test and evaluation for air-breathing and rocket engine installations. Field test & evaluation support.



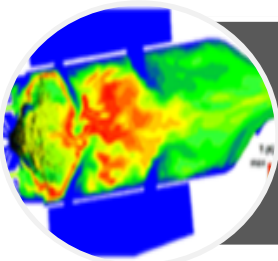
Energetic Materials

Physics-based models and facilities to aid in the formulation, development, test and evaluation of novel propellants and energetic materials.



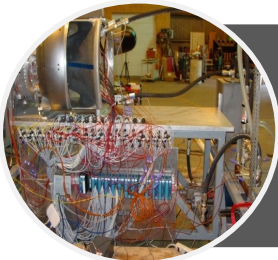
Variable Thrust Rocket Motors

Prototype solid, liquid and gelled hypergolic motor configurations to extend range and maneuverability and improve insensitivity.



Modeling and Simulation

Combustion modeling for gas turbines, rockets, and scramjets. State-of-the-art soot formation, coke deposition, and non-gray radiation models.



Remote Test Facility

Expertise in test facility design, test configuration set-up and installation, test planning, test monitoring, results review, and qualification testing.

Visit www.cfdrc.com for more information

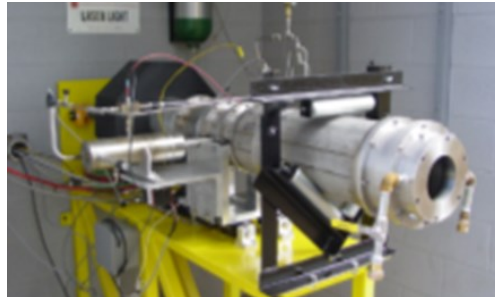
Examples

Air Turbo Rocket

The Ultimate Turbine Based Combined Cycle Engine



Air Turbo Rocket assembly



ATR installed in CFDR test facility



Successful hot-firing of ATR system

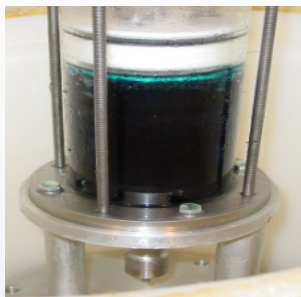
CFDR continues to pioneer the research, development, test, evaluation, and vehicle implementation of the Air Turbo Rocket within tactical missiles, scram jet boost operations, and small launch vehicles at our facilities.

The ATR offers an optimal compromise between specific impulse and specific thrust in numerous vehicle installations currently under consideration.

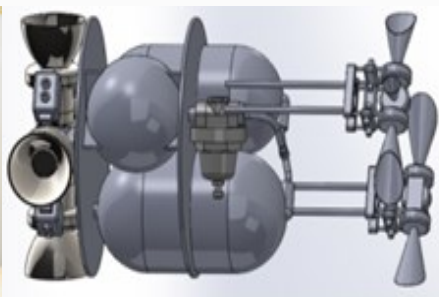
Propellant Gellation

Insensitive Munition & Performance Enhancement

CFDR contributions continue to be critical in the implementation of propellant gellation within tactical and strategic missiles, kinetic kill vehicle DACS, and next generation launch vehicle platforms.



Gellation equipment and processes

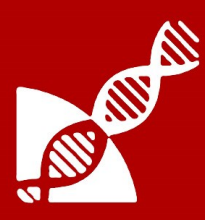


Gel-based DACS system design



Successful hot-firing of gelled propellant system

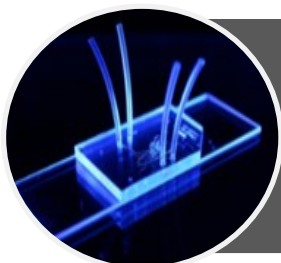
Our efforts include gellation techniques, rheological behavior modeling, component/system test and evaluation using laser diagnostics and system/vehicle integration studies.



Life Science

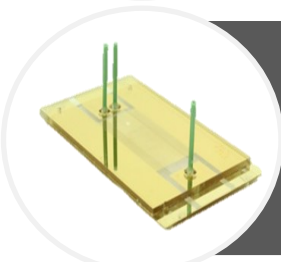
Applications

CFDRC creates new concepts, designs, and prototypes for military medicine and biomedical applications. We have a unique combination of simulation and experimental expertise, and state of the art lab and computing facilities.



Lab-on-a-Chip Devices

Development of pharmaceutical research tools for drug discovery and development, and engineering technologies for medical micro-devices.



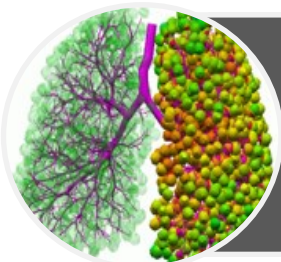
Biological and Chemical Sensors

Leading-edge miniaturized systems for medical and environmental surveillance, detection, and monitoring.



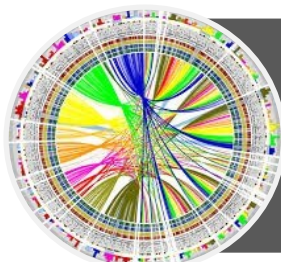
Biomedical Devices

Design, development, and evaluation of biomedical devices and regenerative medicine technologies.



Computational Medicine and Biology

Pioneering multiscale modeling for human body physiology, injury, and interventional/pharmacological treatment.



Systems Biology and Bioinformatics

Development of analysis tools to manage and analyze genomic, proteomic, metabolomics, pathology, and pharmacology data.

Visit www.cfdrc.com for more information

Examples

CoBi Software Suite

Personalized Human Body Avatars for Improved Health, Performance & Protection

CFDRC has developed unique software products and applications for personalized medicine, disease prevention, and improving human performance. Central to our approach is a digital human equivalent known as a Personalized Health Avatar or a Warfighter Avatar specifically for DoD applications. Customers include DoD, NIH, FDA, and CDC government agencies, as well as pharmaceutical and biomedical companies.

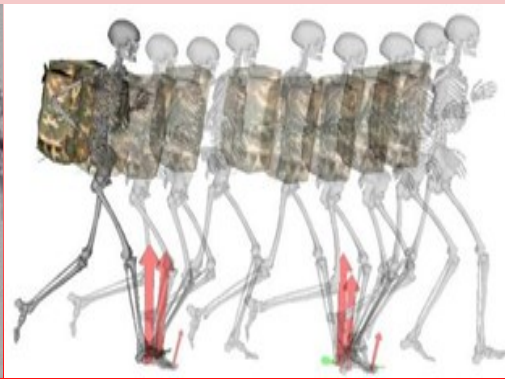
CoBi-MP

CoBi-MP software solves multiphysics problems for a broad range of disciplines including: fluid flow, structural mechanics, heat transfer, bio-chemistry, etc.



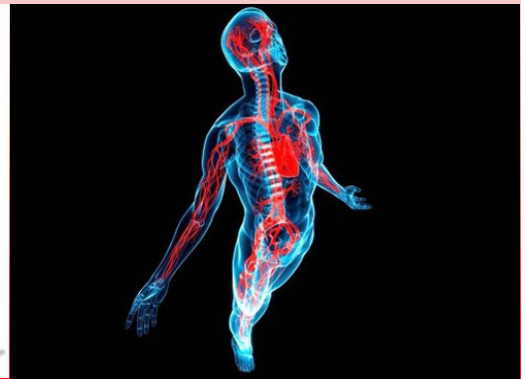
CoBi-Dyn

CoBi-Dyn is a bio-dynamics software framework and GUI for modeling virtual warfighters and their equipment.



CoBi-Pharma Lab

CoBi-Pharma Lab software is a unique computational pharmacology (PBPK/PD) tool to predict drug distribution in different organs of interest.



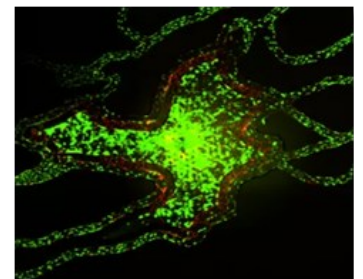
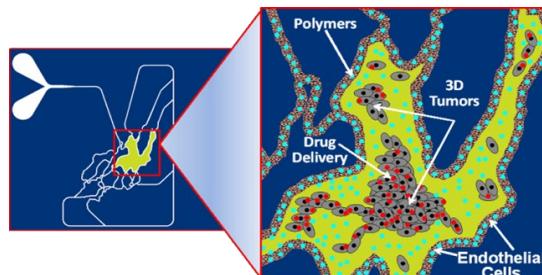
SynVivo

Realistic. Dynamic. 3D Cell-based Assays

CFDRC has developed SynVivo, a physiological, 3D cell-based assay platform that provides a morphologically and biologically realistic microenvironment allowing real-time study of cellular behavior, drug delivery and drug discovery.



SynVivo recreates the complex in vivo vasculature including scale, morphology, fluidics and cellular interactions in an in vitro environment enabling basic and applied life sciences research.





Energy

Applications

CFDRC is creating new and innovative solutions to energy related problems. We have physics-based modeling and analysis capabilities as well as production and test facilities for advanced electrochemical materials and systems development.



Active Materials for Batteries

Development of advanced active materials for lithium-ion and thermal battery systems producing higher energy density and improved safety.



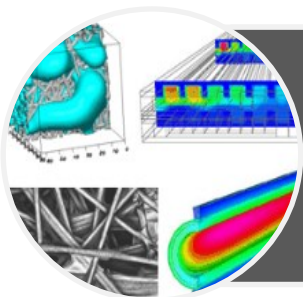
Battery Performance Evaluation

Test and evaluation as well as advanced modeling capabilities to assess performance and lifetime of advanced battery technologies.



Bio-inspired Fuel Cells

Innovative enzymatic fuel cell technology for bio-inspired power generation from readily available bio derived fuels (sugars).



Fuel Cell Modeling

State-of-the-art multiphysics modeling and simulation of fuel cell systems for design, analysis, and performance evaluation.

Visit www.cfdr.com for more information

Examples

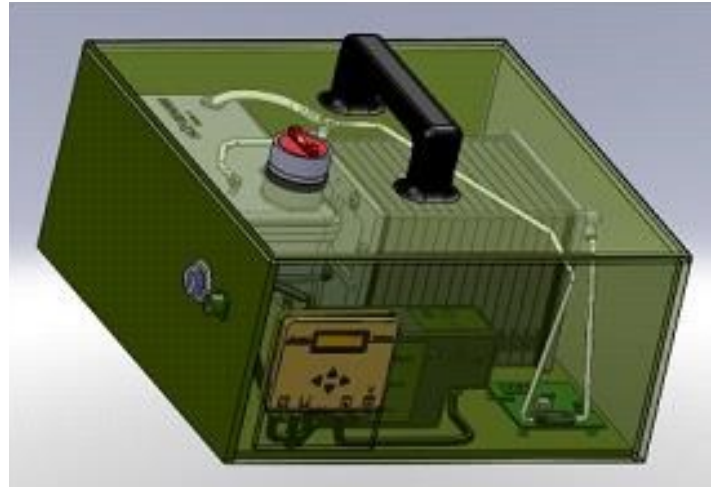
Bio-Battery

Clean, Renewable Power Source

The Bio-Battery™ developed by CFD Research Corporation is a novel power source that converts commonly available fuels directly into electrical energy. The Bio-Battery uses enzymes to convert the fuels into energy similar to the way biological systems use enzymes to convert food into energy.

Benefits:

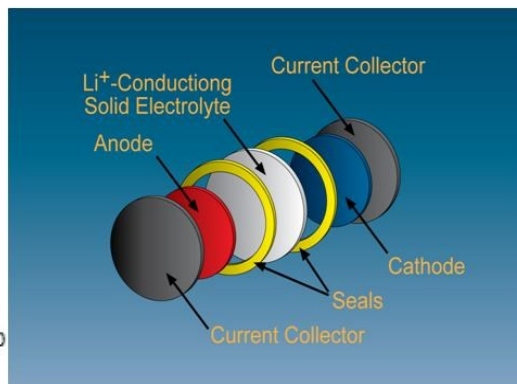
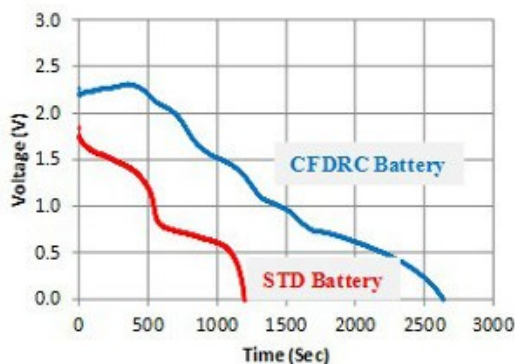
- 10X more energy than Li-ion batteries
- Uses multiple fuel sources: sugars, hydrocarbons (e.g., JP-8), bio-fluids
- Utilizes renewable biocatalysts
- No thermal or acoustic signature
- Allows for instant recharge



Thermal Batteries

More Energy / More Power Through Advanced Material Solutions

CFDRC is increasing the energy density of thermal batteries by 3-5X. The increased capacity is the result of nanostructured electrodes and novel chemistries which lead to longer runtime or smaller packaging for current missile systems and other applications.



High Capacity: The capacity of our cathodes is 2-4 times higher than that of the FeS₂ and CoS₂ cathodes.

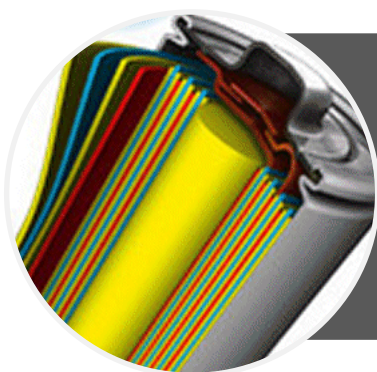
High Power: The novel cathodes produce operating voltages >2.5 V allowing for smaller overall footprints.



Materials

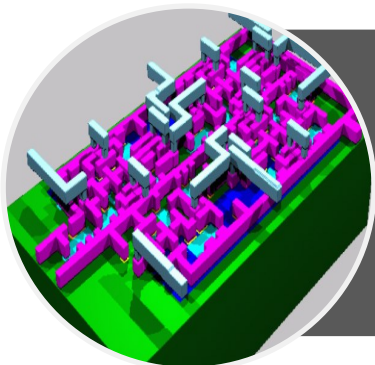
Applications

CFDRC's cross-disciplinary team is accelerating discovery and development of next generation materials that impact energy, semiconductor and aerospace markets. The team leverages advanced, multi-scale, predictive software tools with significant depth in materials, physics and chemistry to solve difficult material challenges for our customers.



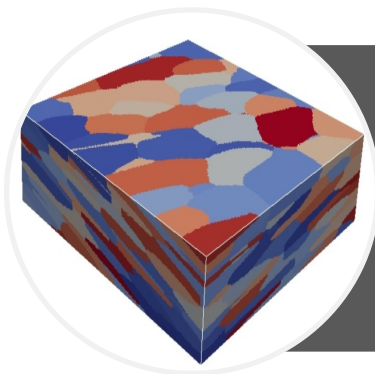
Next Generation Energy Storage

Products and services that accelerate innovation in energy storage, focusing on materials for next generation devices and models for Smart Energy Management.



Electronics in Extreme Environments

Innovative products and services that enable electronics to thrive in extreme environments created by space weather, radiation, plasma and extreme temperatures.



High Performance Materials

Advanced material and environment models, spanning length scales from atoms to systems, that allow us to predict material properties and provide novel solutions to difficult challenges.

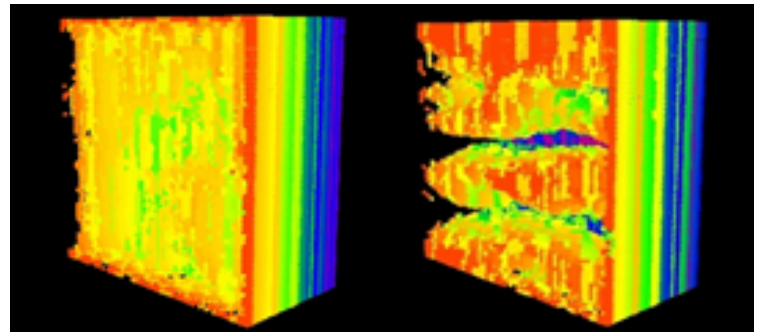
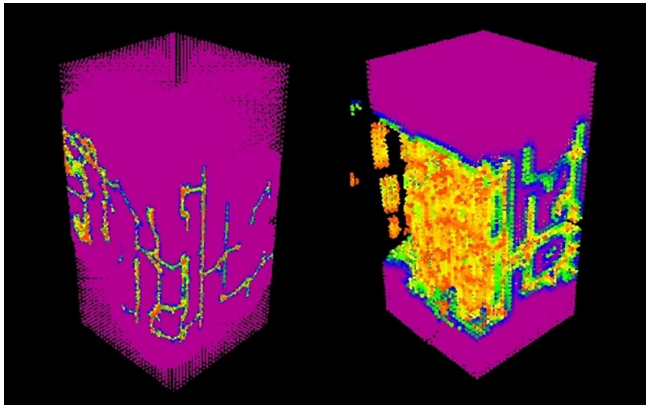
Visit www.cfdrc.com for more information

Examples

Coupled Computational Materials

Linking Materials Damage Models with Operating Environments

The team is advancing models for next generation materials at the nanoscale with an approach that unifies the mechanics of continuous and discontinuous media to predict damage, wear, failure, and effects on material strength.



Extensive experience solving difficult challenges for a variety of material systems including aerospace alloys, thermal barrier coatings, and ceramic composites to name a few.

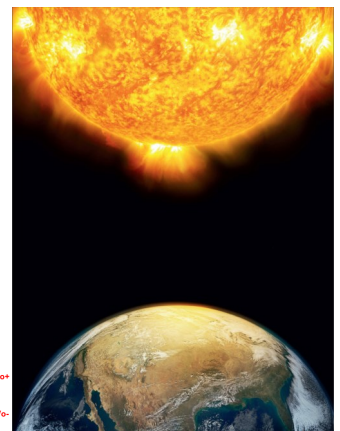
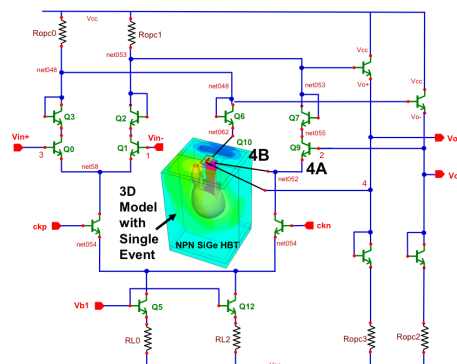
Space Weather to Radiation Effects

Forecasting from Solar Event to the Effect of Radiation on Electronics

Solar flares create a dynamic radiation environment that can adversely affect both people and electronics in spacecraft, high-altitude airplanes, and terrestrial systems.

The team develops tools that model the solar radiation environment from the sun to downstream effects on astronauts, electronics, and shielding materials, enabling a comprehensive “event-to-effects” capability.

Mixed-Mode analyses of radiation effects in analog/mixed-signal systems across extreme temperatures helps develop novel radiation-hardened designs.





Cyber

Applications

CFDRC provides solutions for the challenging problems affecting emerging mobile devices and cloud-based systems in today's highly interconnected world. We apply our expertise in cyber security and computer networks to protect data in massively distributed systems.



Integrity

Development of cryptographic techniques to protect the integrity of sensitive data in complex network environments.



Trust

Application of automated techniques to allow higher confidence levels and reduce risk in network services and data.



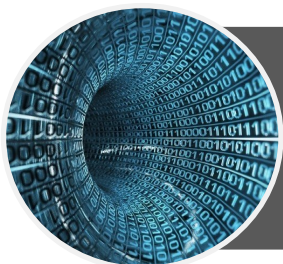
Quality

Development of novel machine learning technologies to determine information quality based on multiple quality matrices and user preference.



Access Control

Semantic connections between users and data are instituted to determine need-to-know accurately and in real time.



Data Mining

Efficient and effective algorithms have been developed to evaluate and analyze network information and large data sets.

Visit www.cfdrc.com for more information

Examples

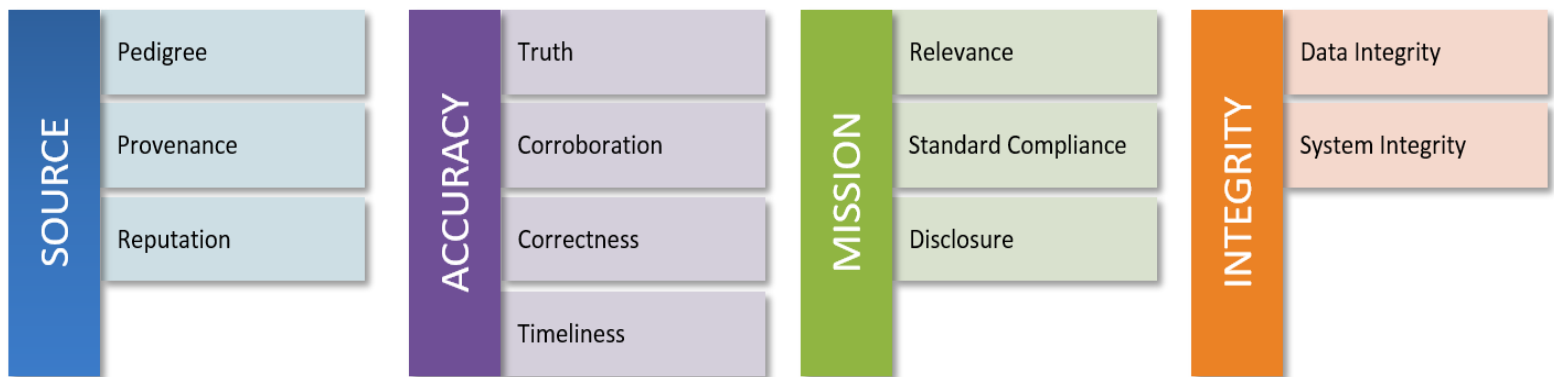
Secure Information

Establishing Trust in Information

Efficient methods of establishing trust in information from Service-Oriented Architectures and Big Data

Determines the Quality of Information (QoI) of Services and Data

- Quality of data; Certainty of measurement
- QoI measurements based on categories and metrics



Easy to Acquire Information Proximity-Based Access Control to Information

Access Control and awareness via logical proximity

- Determines likelihood that access to data is required
- True examination of “need-to-know”
- Beyond spatial, temporal, organizational, and operational domains

Determines Proximity Metric based on

- Quantitative assessment
- Semantic analysis of linked-data connections

