



ENGINEERING MISSION SUCCESS

Aerospace Engineering Disciplines

Guidance, Navigation, and Control
Autonomous Rendezvous and Docking

> Computational Fluid Dynamics

Thermal Modeling and Analysis
Structural Analysis and Mechanical Simulation
Space Systems Engineering
Payload Integration and Integration Support
Launch and Space Operations Planning

CFD Core Competencies

Steady/unsteady fluid flow analysis including turbulence modeling

Euler (low-fidelity) and Navier-Stokes (high-fidelity) analysis

Grid generation (structured or unstructured meshing)

Generation of aerodynamic loads for structural and aerothermal analysis

Generation of aerodynamic forces and moments for Six Degree of Freedom (6DOF) simulation and performance analysis

Aerodynamic analysis of hardware components during store/stage separation

Wind tunnel testing for validation of CFD models

Pre/post-processing of results and flow visualization

About bd Systems

bd Systems is a woman-owned small business that provides engineering and information technology services for government and private industry. Based in Torrance, California, bd Systems has over 20 operating locations nationwide.

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Computational Fluid Dynamics in Aerospace Applications

Computational Fluid Dynamics (CFD) technology is now widely used to reduce design and development cost for aerospace systems. CFD studies fluid flow physics to analyze design options and develop more realistic models to predict system design performance, reducing need for expensive hardware testing. bd Systems has significant recent aerospace CFD analysis experience and stands ready to support competitive development of your aerospace systems.



CFD is used to develop databooks for predicting wind tunnel performance. Wind tunnel testing then validates the CFD data and models. CFD contributes to significant cost savings by reducing the number of design models and wind tunnel test cases required. CFD also enables reliable analysis of flight modes and regimes that are simulated accurately and safely during wind tunnel testing.



bd Systems has a proven track record of applying CFD tools and analytical techniques across a broad spectrum of air and space systems, including missiles and launch vehicles. For the NASA/Boeing High-Speed Research (HSR) airplane design, we conducted aerodynamic and aero-elastic analyses of flexible wing and wing/body model concepts for a supersonic passenger jet and High Speed Civil Transport (HSCT) at Mach 2-3 under aerodynamic loading. For the NASA/Boeing Space Launch Initiative (SLI) program, bd Systems successfully applied low- and high-fidelity CFD analysis to assess second generation Reusable Launch Vehicle (RLV) aerodynamics and demonstrate the RLV's feasibility and cost effectiveness. We compiled a comprehensive aerodynamic databook and successfully validated our predictions against hundreds of hours of wind tunnel testing. Our CFD models resulted in significant cost savings for these programs and dramatically narrowed the focus for wind tunnel testing.



Under the NASA/Boeing Orbital Space Plane (OSP) program, our personnel supported architecture trade studies by analyzing aerodynamic characteristics of medium- and heavy-lift launch vehicles with several various crew module architectures during ascent and reentry over subsonic and hypersonic flight regimes. These studies evaluated the relative performance of the Delta IV and Atlas V launch vehicles; the scaled Apollo Command Module, Gemini, Mercury, and Soyuz capsules; and the biconic Crew Transfer Vehicle (CTV) and Aerobraking Transfer Vehicle (ATV) as candidate program architectures.



Recently, bd personnel generated an aerodynamic database for the DARPA/USAF/NASA FALCON phase 1 program to support the design of a responsive, low-cost (under \$5M) launch vehicle—a vehicle capable of launching from any US location and delivering payloads or the Hypersonic Technology Vehicle (HTV) into low Earth orbit. Our personnel also generated an aerodynamic substantiation databook based on CFD results and validated using wind tunnel data.

bd Systems stands ready to support your CFD analysis needs to meet cost-effective program development objectives.