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Scaling 3D Solutions with AI: A Faster Path to Production-Ready Applications

By AMC Bridge, a trusted digital transformation and AI consulting partner for engineering, manufacturing, and construction enterprises worldwide.

Executive Summary

Enterprises create custom applications to use 3D engineering data across product development, sales, procurement, manufacturing, support, and maintenance. These applications automate specialized workflows, reduce rework, and improve access to engineering information across the product lifecycle.

Geometry kernels provide the mathematical foundation for creating, modifying, analyzing, and validating 3D geometry. Teams often use open-source kernel technology to develop a prototype, then replace it with a production-grade component such as Parasolid®*, Siemens Digital Industries Software's geometric modeling technology, when the application moves into MVP and production use.

This transition is time-consuming and costly and requires deep geometry-kernel expertise, creating a major barrier to moving custom 3D applications into production. AMC Bridge developed an AI-assisted engineering methodology to address this challenge. The methodology was tested by applying it to selected geometric modeling functionality in FreeCAD* and SolveSpace*, migrating that functionality from the applications' existing geometry foundations to Parasolid®.

For the evaluated reference-migration scopes, the methodology delivered 2.1× software engineering productivity for FreeCAD and 3.6× for SolveSpace compared with traditional, non-AI-assisted migration. Technical decisions, testing, and validation remained under engineering control.

**Additional information and official links are provided at the end of this white paper.*

1. Building Production-Ready 3D Applications

3D engineering data supports design review, product configuration, manufacturing planning, inspection, maintenance, service, training, simulation, and customer-facing visualization. Enterprises create custom applications to address specialized processes, proprietary engineering knowledge, data and system integration requirements, and differentiated user experiences that standard software does not fully support.

Custom 3D application development typically begins with a prototype to validate technical viability, business value, workflow, and user experience. MVP and production use introduce broader functionality, demanding integrations, sustained workloads, stricter geometry requirements, predictable behavior, and long-term support needs. The geometry kernel therefore becomes a core production dependency rather than a prototype implementation choice.

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2. The Kernel Migration Challenge

Kernel dependencies extend through data structures, modeling operations, business logic, user interactions, data exchange, automated tests, and geometry validation. Migration requires teams to identify these dependencies, map equivalent operations, refactor kernel-specific code, implement target-kernel behavior, and verify functional and geometric results. The work demands specialized geometry expertise, substantial engineering effort, and disciplined validation.

From a business perspective, kernel migration is an investment that delivers limited immediate value but establishes the technology foundation for a production-ready 3D application. Applying AI-assisted engineering to the migration process reduces the engineering effort required for the defined scope, making the investment less burdensome and easier to justify.

3. Evaluating AI-Assisted Kernel Migration

AMC Bridge developed an AI-assisted engineering methodology for kernel migration that combines sufficient technical context, reviewable implementation units, continuous validation, and engineering ownership of architecture and final decisions.

To apply and test the methodology, AMC Bridge selected FreeCAD and SolveSpace, two open-source CAD applications with different geometry foundations, codebase sizes, and architectures. FreeCAD uses Open CASCADE Technology, while SolveSpace uses a custom geometry kernel. Parasolid® served as the common target kernel. These differences provided distinct technical conditions for assessing how application architecture, kernel dependencies, migration scope, and validation requirements influence engineering effort.

The reference work covered selected geometric modeling functionality. For both applications, AMC Bridge migrated the evaluated functionality from their existing geometry foundations to Parasolid® and compared the AI-assisted methodology with traditional, non-AI-assisted migration using tracked software engineering man-hours for the same implementation scope. Testing and technical review remained part of the engineering process.

4. Results

Application	Application overview	Productivity improvement with AI-assisted migration
FreeCAD	Open-source parametric 3D modeler based on Open CASCADE Technology	**2.1× productivity (110% increase)**
SolveSpace	Free, open-source parametric 2D/3D CAD application	**3.6× productivity (260% increase)**

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Both results compare the AI-assisted methodology with traditional, non-AI-assisted migration using tracked software engineering man-hours for the same implementation scope. The difference in productivity reflects three characteristics of the evaluated applications: codebase scale, geometry-kernel architecture, and the extent to which kernel dependencies are embedded across the application.

FreeCAD is a full-featured parametric CAD platform with a codebase more than an order of magnitude larger than SolveSpace's. Its migration required adapting Open CASCADE Technology's object-oriented C++ interface to Parasolid®'s function-based API. FreeCAD's kernel dependencies also extended beyond geometry operations into user-interface code and application logic, requiring additional refactoring to isolate those dependencies.

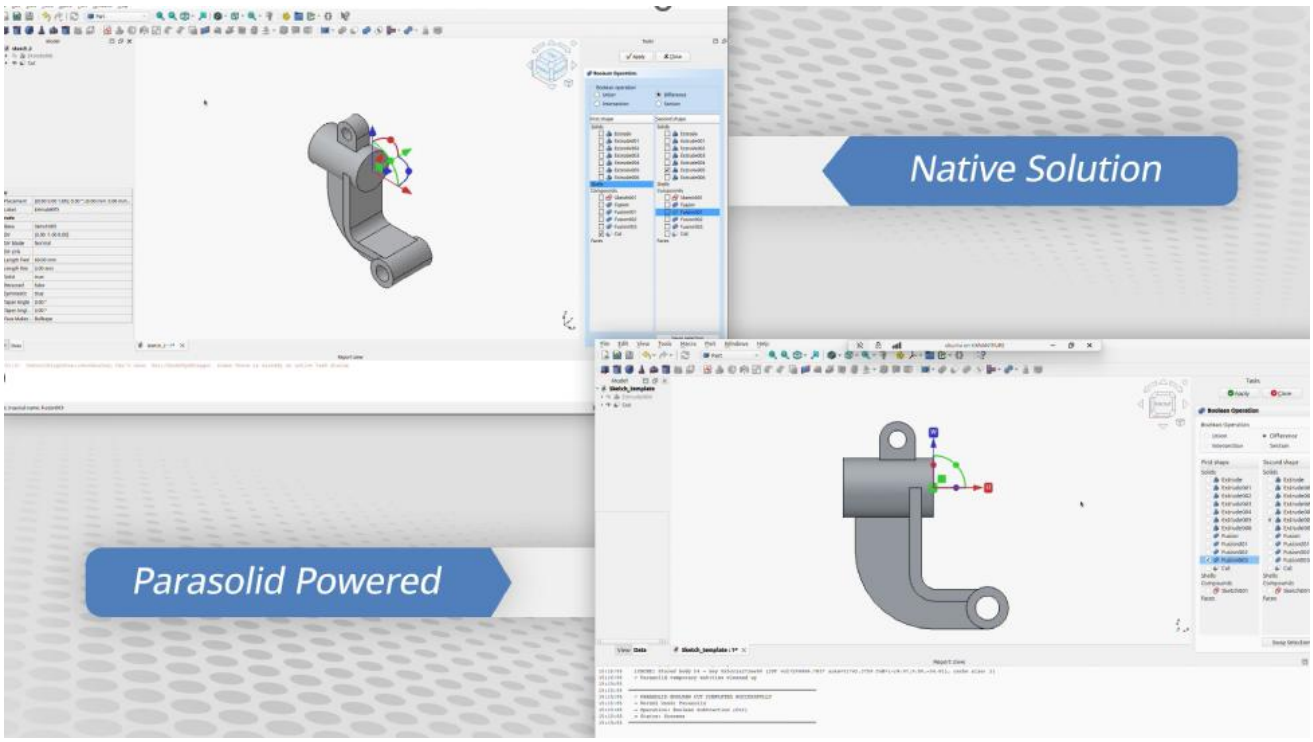


Figure 1: FreeCAD running with its native Open CASCADE Technology geometric modeling kernel and with the Parasolid-powered implementation.

By comparison, SolveSpace is a lightweight, sketch-driven 3D modeler whose custom geometry kernel was architecturally closer to Parasolid®, allowing a more direct transition within the evaluated scope. Together, these factors contributed to the higher productivity improvement measured for SolveSpace.

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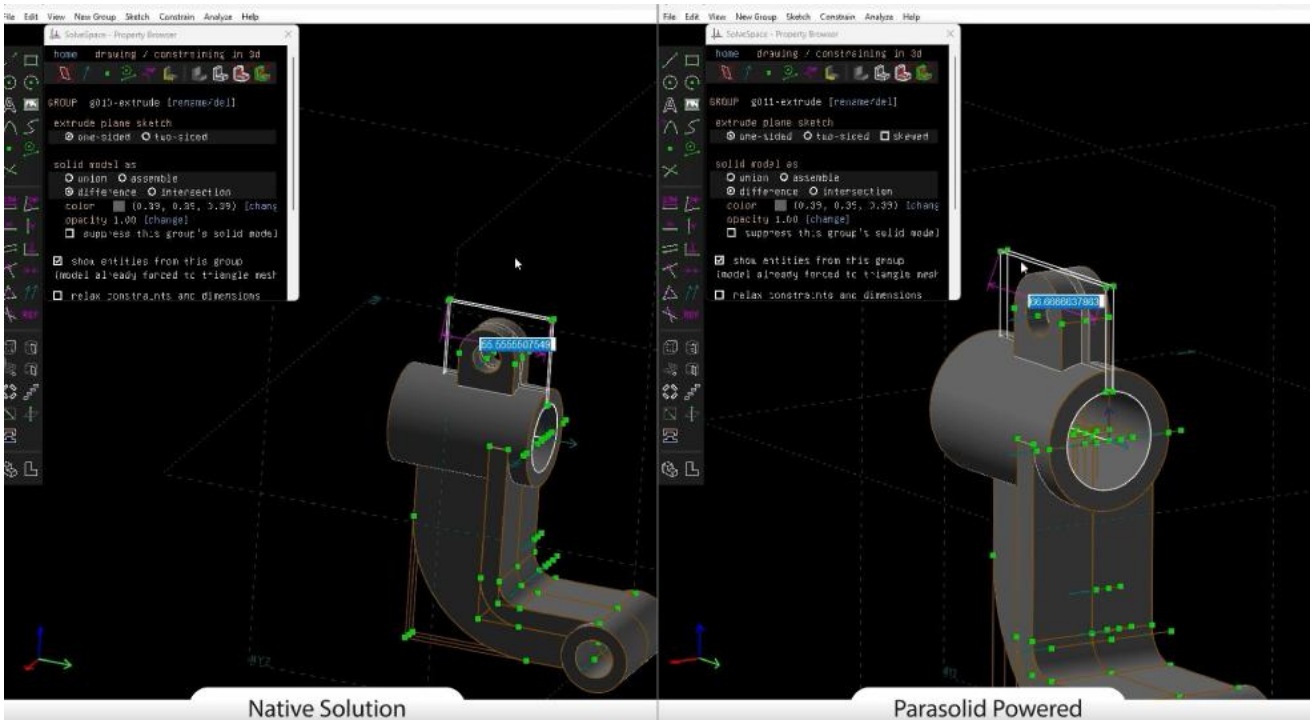


Figure 2: SolveSpace running with its native geometric modeling kernel and with the Parasolid-powered implementation.

5. Reducing the Engineering Burden of Kernel Migration

The reference results demonstrate that the methodology developed by AMC Bridge significantly reduced the engineering effort required to migrate selected functionality in 3D applications from their existing geometry foundations to Parasolid®. Across the evaluated FreeCAD and SolveSpace scopes, the measured productivity improvements were equivalent to approximately 52% to 72% fewer engineering man-hours than traditional, non-AI-assisted migration for the same implementation scope.

While productivity improvements are significant, AI-assisted kernel migration is not an automated process. It requires careful planning, geometry-kernel expertise, engineering review, testing, and functional and geometric validation to ensure that the migrated functionality preserves the application's expected behavior and meets its quality requirements.

About AMC Bridge

AMC Bridge is a trusted software technology partner for engineering, manufacturing, and construction enterprises, whether they are actively pursuing AI-driven digital transformation or only beginning to recognize its potential. We help organizations to move beyond experimentation and achieve consistent ROI by delivering production-ready software and end-to-end solutions for their transformation journey.

We design, build, and integrate enterprise-grade software – applications, workflow extensions for CAD/PLM/BIM, data integrations, AI-enabled features – and deploy them with monitoring and lifecycle management so they remain reliable over time. Our services include assessing data readiness; preparing

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and unifying product and project data; and embedding AI into the workflows teams use every day. With 25+ years of industrial software expertise and deep ecosystem partnerships, including Aras, Autodesk, Bentley, Dassault Systèmes, PTC, Siemens, Tech Soft 3D, and others, we empower enterprises to move confidently from experimentation to operational AI at scale.

AMC Bridge brings extensive experience across the Siemens technology ecosystem, including 150+ projects involving Siemens PLM Components and technologies, 80+ clients benefiting from Siemens-related expertise, and 400+ engineers with specialized Siemens knowledge. This experience spans Parasolid®, D-Cubed®, Kineo™, JT®, Teamcenter®, NX®, and Solid Edge OEM.

AMC Bridge combines geometry-kernel expertise, production-grade software delivery, and AI-assisted engineering practices to assess, plan, implement, and validate migration to Parasolid®. For more information, visit amcbridge.com.

About Open CASCADE Technology

Open CASCADE Technology, or OCCT, is a freely available open-source 3D modeling kernel and software development kit for applications that work with 3D CAD data. Its C++ libraries provide capabilities for surface and solid modeling, visualization, data exchange, and application development. For more information, visit opencascade.com.

About Parasolid®

Parasolid® is a 3D geometric modeling kernel developed by Siemens Digital Industries Software for applications in product design, simulation, analysis, and manufacturing. It supports solid, surface, direct, and convergent modeling and is licensed to more than 200 independent software vendors. More than 350 applications use the Parasolid XT data format, supporting model compatibility across a broad engineering-software ecosystem. For more information, visit the Siemens Parasolid page.

About FreeCAD

FreeCAD is an open-source parametric 3D modeler designed primarily for real-world product and object design. It supports parametric modeling, allowing users to modify designs by changing model-history parameters, and uses Open CASCADE Technology as its geometry engine. FreeCAD runs on Windows, macOS, and Linux. For more information, visit freecad.org.

About SolveSpace

SolveSpace is a free, open-source parametric 3D CAD application distributed under the GPLv3 license. It supports 3D part modeling, 2D drawing, parametric assemblies, mechanism design, and the preparation of data for manufacturing workflows. SolveSpace runs on Windows, macOS, and Linux. For more information, visit solvespace.com.