EUREKA COA-CFD

Cloud-based Online Access to Computational Fluid Dynamic Simulations

Programm / Ausschreibung	IWI, IWI, Basisprogramm Ausschreibung 2023	**Status**	abgeschlossen
Projektstart	01.04.2023	**Projektende**	29.02.2024
Zeitraum	2023 - 2024	**Projektlaufzeit**	11 Monate
Keywords			

Projektbeschreibung

CFD-Simulationen werden bei der Entwicklung neuer mechanischer Teile in der Automobil-, Luft- und Raumfahrt- und Militärindustrie eingesetzt, um die Effizienz zu steigern. CFD-basierte Experimente sind im Vergleich zu konventionellen Methoden kostengünstig und können Eigenschaften abschätzen, die nicht empirisch gemessen werden können. Engineering Software Steyr GmbH (ESS) ist ein Innovator auf dem Gebiet der CFD-Simulationen und hat neue CFD-Fähigkeiten (partikelbasierte Methoden) in Form von vier neuen Solvern entwickelt und diese hybridisiert, um die Benutzerfreundlichkeit zu erhöhen. CFD-Simulationen erfordern großes Fachwissen, das kleinen und mittleren Unternehmen (KMU) oft nicht zur Verfügung steht. Dies schränkt ihre Wettbewerbsfähigkeit als Anbieter für die verarbeitende Industrie ein. Das Ziel des Konsortiums COA-CFD (Cloud-based Online Access to Computational Fluid Dynamic Simulations) ist die Demokratisierung von CFD-Simulationen bei gleichzeitiger Förderung modernster IKT-Fähigkeiten. Dies wird die Nutzung durch Nicht-Experten ermöglichen und das Feld für ein breiteres Publikum und breitere Märkte öffnen. Die Demokratisierung wird durch die Hybridisierung verschiedener Solver und durch die Verbesserung der Schnittstelle zur menschlichen Interaktion erreicht. Dies wird eine On-Demand-Cloud-Lösung ermöglichen. Darüber hinaus wird die Universität Kaiserslautern (TUK) ein Framework zur Designoptimierung in die Lösung integrieren, um eine noch bessere Benutzererfahrung zu ermöglichen. Scientific Solutions Systems (SSS) und IONOS werden die GAIA-X1-konforme Cloud-Hardware-Basis und Konfigurationsmechanismen entwickeln und aufbauen, um eine nahtlose Bereitstellung von Software-Plattformen zu ermöglichen, die hohen Arbeitslasten standhalten. Es werden Algorithmen des maschinellen Lernens entwickelt, um die geplante Auslastung der Cloud-Ressourcen vor der Aktivierung von Simulationen vorherzusagen und so die Fähigkeit zur Planung und Zuweisung von Ressourcen für anspruchsvolle Aufgaben in einer dezentralen Cloud-Umgebung voranzutreiben.COA-CFD umfasst die Demonstration spezifischer Anwendungsfälle, um die Plattform in realen Szenarien auf den eCargo-Fahrrädern von Citkar (CIT) und Top-Coating-Anwendungen auf Fahrzeugen von AUDI zu testen, die von MYB Mühendislik Yazilim A.S. (MYB) entwickelt wurden.

Endberichtkurzfassung

In the project year 2023-2024, the whole consortium had good cooperation and was successful in aligning project progress with the original plans. The main achievements of COA-CFD in the last project year are:

Smooth cooperation: We established a smooth cooperation network in terms of project management, research and development, as well as marketing network expansion. The well-managed communication and cooperation ensure that the project progresses as the original plan. Furthermore, to expand the application of the developed technologies, we sucessfully included more partners and more use cases, which will officially start in the 2024-2025 project year.
Enhanced solver capability : We enhanced the hybrid solver and the free-surface LDD solver. Now the hybrid solver is able to simulate multiphysical problems involving fluid flow, moving bodies, electrostatic fields, Lagrangian particles, and film flow. It has reached a certain maturity for complex industrial problems like coating and spray, which are otherwise difficult to simulate. With further enhancements in the next project year, the solver will be fully ready for industrial applications. The LDD solver is developed based on SPH, but it has superior accuracy and efficiency, which will find wide applications in industrial processes involving free-surface flows, and fluid splashing.
Integration with design optimization : The main goal of CAE simulations is to find optimal settings for design and process. With design optimization techniques, the solvers can be used to find the optimal settings without manual trials and errors, and the number of iterations can be greatly reduced. In the last year, we managed to integrate design optimization with our electrostatic solver, through the work including defining the optimization target function, implementation the constraints, integrating the design optimization and algorithmic differenciation algorithms, and designing the operation workflow. The design optimization equiped solver can be used to give optimal process settings based on various choices of targets, including minimizing energy, minimizing material consumption, and maximizing processing quality.
Simplified GUI creation : To be able to create GUI conveniently for a large number of applications by non-developers, we proposed the module GUI framework. Now a partially completed module GUI framework allows non-developers to produce preliminary GUIs. This is achieved by modulizing the GUI functionalities for different operations, and creating a GUI creator which allows engineers to select a series of functionalities and design the GUI following his own workflow.
Cloud accessibility : The AlsimCloud platform is enhanced with improvements, including integration with AWS and IONOS, enable the automatic selection of backend resources, enhancing the efficiency and scalability of cloud-based CFD simulations. Furthermore, API clients based on Java and Python are released for the customers allowing versatile way of access AlsimCloud. The cloud platform has been serving the consortium and partners are using it for simultions. It is been tested for wider use beyond the consortium.
Water management software : Through the cooperation with CITKAR, we developed a software module named alsim Paint Shop Washing, which can be used in the water management in the paint shop process and beyond. Any processes involving surface washing, rinsing, spray washing, and water-proof testing, can be simulated with the developed module. The simulation workflow of the module was designed with CITKAR to consider the user habits of engineers, and to allow intuitive use of the software.
Top coating simulation : We had a great leap towards the successful simulation of top coating, which is a widely used technique in manufacturing but is different to be simulated and till now no dedicated commercial solution is available in the market. The main functionalities of the solver are ready, although some improvements will follow in the next project year to ensure accuracy moving bell simulation with robotic paths. The module is being tested using experimental data. The GUI is preliminarily built and the initial design of the simulation workflow is finished. Several more iterations will be carried out. The goal of developing a top coating simulation software is achievable with further enhancements and testing.

Projektpartner

- ESS Engineering Software Steyr GmbH