Game-Like Terrain, On-Demand: Solving Terrain Challenges Through Enterprise Terrain Management.

Abstract — Traditionally, making terrain for high-fidelity simulation is challenging. Acquiring good source data, storing that data, building correlated terrain for multiple runtimes, synchronizing data between different simulation clients (e.g. dynamic terrain updates) and editing data "on the fly" are all difficult terrain-related tasks that, historically, have resulted in expensive development and long lead teams for delivering high fidelity terrain data to the point of need. New, cloud-enabled technologies are solving these problems, funded through initiatives including the US Army's One World Terrain (OWT) program. Mantle ETM (Enterprise Terrain Management) is a custom-built platform based on proven COTS components and expert design/development services for creating simulated terrain for training, mission rehearsal, visualization and terrain analysis. This paper describes how Mantle ETM solves terrain challenges and presents several case studies showing how terrain development is moving to the Cloud, to support the Military Metaverse.

Technologies and Architectures
- Rapid mission-specific synthetic environment generation
- Upgrading legacy systems to support today's training needs

1 Introduction

Traditionally, making terrain for high-fidelity simulation is challenging. Acquiring good source data, storing that data, building correlated terrain for multiple runtimes, synchronizing data between different simulation clients (e.g. dynamic terrain updates) and editing data "on the fly" are all difficult terrain-related tasks that, historically, have resulted in expensive development and long lead teams for delivering high fidelity terrain data to the point of need. New cloud-enabled technologies are solving these problems, funded through initiatives including the US Army's One World Terrain (OWT) program. Mantle ETM (Enterprise Terrain Management) is a customizable platform based on proven COTS components and expert design/development services for creating simulated terrain for training, mission rehearsal, visualization and terrain analysis. This presentation describes how Mantle ETM solves common terrain challenges and presents several case studies showing how terrain development is moving to the Cloud.

Global terrain for training and simulation is rapidly becoming more practical thanks to advancements in remote sensing, storage and transmission, and cloud computing. The challenge for simulation vendors is providing a visually realistic environment while also supporting simulated reasoning, procedurally enhanced detail, correlated output to different simulation clients, through an architecture that supports additional source data inputs, data processing services, and new simulation format outputs. Simulation users expect terrain "on-demand" in a similar manner to how apps like Google Maps instantly provide high fidelity data to an iPhone. Traditionally, developing terrains for military simulation takes weeks to months depending on the formats needed and data available. The U.S. Army, for example, has described its need to move away from supporting many different terrain formats toward a "dynamic One-World Terrain … accessible on your device/platform"[1].

Working in partnership with Government organizations including the U.S. Army, BISim and its subsidiary TerraSim designed and developed Mantle ETM to ingest a variety of common and novel global data sources, procedurally enhance the data to a level of detail suitable for simulation, and make the results available to disparate clients. Mantle ETM uses a containerized component architecture built on open standards (OGC/SISO)

1 https://usacac.army.mil/sites/default/files/documents/cact/Combined_STE_Industry_day_brief.pdf

for ingesting static and streamed data sources, combined with using RESTful APIs to formalize component communication. For most simulation runtimes the geospatial input data must be curated, conflated, and otherwise prepared. This implementation simplifies server component integration so that data can more easily be shared and processing customized for various runtimes.
Modern simulations demand high fidelity at all altitudes, and this has posed new challenges for terrain developers. Unlike a flight simulator that typically requires a low fidelity ground representation, the new generation of rotary wing and ground simulators require complex terrain that is representative of the real world. This has necessitated advancements in procedural generation of terrain to add detail to otherwise sparse geo-referenced source data, e.g. adding grass and other vegetation, power lines, cross walks, sidewalks and many other details that enable terrain for simulation to look "real". While most game engines already support procedural generation, the techniques are specific to the game engine, e.g. procedural enhancement in Unreal Engine[2]. Mantle ETM is unique in providing game-like procedural generation but enabling the output to be streamed to multiple runtime engines and constructive simulations, ensuring correlation between different systems with millimeter precision.

Dynamic terrain is another key challenge when integrating different simulation engines or image generators. Dynamic terrain refers to any event that changes the terrain both before and during simulation - from terrain editing through to in-game kinetic events like craters from explosions and building or bridge destruction. While these events can be communicated between simulations through standards like Higher Level Architecture (HLA), the in-game result varies widely from simulation to simulation - especially those that represent the environment in 3D (either visually or in simulation). We are working to solve dynamic terrain through Mantle ETM, by streaming both terrain data and dynamic changes to that data to the connected simulations that need it while maintaining perfect correlation. Currently supported runtimes include VBS4, VBS Blue IG and Cesium, with prototype support for the Unreal Engine.

Mantle ETM was recently demonstrated using data from LuxCarta BrightEarth, which uses AI techniques to produce enhanced GIS data including automated building and tree extraction and land use classification. Input data from LuxCarta was automatically imported into Mantle ETM, conflated with VBS4 base globe data and streamed to VBS4 and Cesium instances, resulting in highly realistic, geo-specific 3D terrain with accurate vegetation and building density, ready for use in simulation. BISim recently announced a partnership with Blackshark.ai, providing another high-quality, geo-specific data source that will be streamed to or downloaded for multiple runtimes through Mantle ETM.

The conversion from traditional / legacy terrain generation and conversion tools to the Cloud is an important and necessary step for organizations to take, to dramatically increase the speed of terrain development and leverage high quality online data sources from companies like Maxar, Luxcarta and Blackshark.ai. Traditionally, terrain generation pipelines build runtime-specific terrain from common source data, with limited procedural generation and limited or no support for dynamic terrain. The new approach takes full advantage of procedural terrain, ensures exact correlation and fully supports dynamic terrain – while leveraging the natural benefits and flexibility of cloud deployment (e.g., increased speed of terrain generation through parallel processing, and naturally separating the underlying web services from the web-based user interface).

Enterprise terrain management is the focus of high profile projects like the U.S. Army's One World Terrain (OWT), and streaming this data to multiple runtimes with perfect correlation is critical to the success of the next generation of cloud-enabled simulation federations.

Top takeaways:
- How Cloud-enabled technologies have solved major terrain generation challenges

2 https://dev.epicgames.com/community/learning/tutorials/j4xJ/unreal-engine-introduction-to-procedural-generation-plugin-in-ue5-2

- How premier military organizations like the US Army are actively moving terrain development to the Cloud
- The steps to transition legacy terrain development methods to a modern and efficient Cloud-enabled approach

Author/Speaker Biography

Peter Morrison co-founded Bohemia Interactive Simulations (BISim) in 2007 and he worked for the company as CEO until 2013. Pete is now BISim's Chief Commercial Officer (CCO). As CCO, Pete is responsible for coordinating Product Management, Marketing and Sales to drive business growth. He focuses on strategic customer relationships and representing the voice of the customer in strategic discussions. Pete is an evangelist for the use of game technologies and other COTS-type products and software in the simulation training industry. Prior to working for BISim, Pete served as a Signals Corp officer in the Australian Army.