The role of advanced FEA in bringing Martian samples to Earth

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Background

Due to a series of successful Mars exploratory missions, the space exploration community, including NASA and ESA, has become increasingly interested in returning Martian geological and atmos-pheric samples to Earth. In response to this desire, NASA has devised a mission campaign plan called Mars Sample Return (MSR). The notional baseline MSR campaign architecture calls for three launches from Earth spaced over several years. The first mission in the potential campaign is called Mars 2020 and is well into development at the Jet Propulsion Laboratory (JPL) in Pasadena, CA. Mars 2020 would core out, col-lect, and preserve Martian geological samples inside specially designed tubes. The next mission called Sample Return Lander (SRL), would be a rover and launch vehicle used first, for collection of the samples and then, for Mars orbit insertion of those samples within in a spherical container called an Orbiting Sample (OS). The last mission called Sample Return Orbiter (SRO), is a spacecraft that provides communications relay, orbital rendezvous and capture of the OS, and Earth-return delivery of the OS. After the SRO captures the OS it is then inserted and sealed within an onboard rentry vehicle called an Earth Entry Vehicle (EEV). Once the SRO approaches Earth, the EEV is released from the SRO, reenters the Earth's atmosphere, and intentionally impact lands without parachute on a designated landing site at the Utah Training and Testing Range (UTTR).

Abstract

This presentation describes how JPL is currently leveraging the advanced FEA toward the goal of bringing Martian rock and atmospheric samples back to Earth. Although many commercial and proprientary engineering analysis tools are used at JPL, this presentation focuses on areas where the explicit FEA code LS-Dyna is used. Although commercially available for many years, advanced FEA tools have only more recently been gaining main-stream recognition as a powerful and effective tools for supporting engineering product development. This presentation showcases through specific examples how advanced FEA is becoming an indispensable engineering tool at JPL. LS-Dyna is used in support of all three potential MSR missions. The discussed examples are: Mars 2020 percussion drill analysis, Mars Assent Vehicle in-space payload ejection kinematics, OS impact analysis and tube response, and EEV soft soil impact mod-eling. In each case, results such as kinematic response, loads, and stresses are explained. A summary of the presenter's professional career starting from undergrad at UW through current employment at JPL is also discussed.

Biography

Scott Perino received his BS in mechanical engineering at the Univer-sity of Washington in 2009. Prior to completing his BS degree, Scott, a US Army reservist, was called up to serve for one year in Ramadi, Iraq. Following graduation, he spent eight months in Seoul, Korea to learn the Korean language, and also lived in Australia for six months further exploring the world. After his time abroad, he went back to school at Virginia Tech and completed his mechanical engineering Ph.D. in 2014. Scott's research focused on applications of advanced FEA and the development of specialized impact absorber technologies for a NASA parachute-less reentry vehicle called the Earth Entry Vehicle. After graduating from VT, Scott went on to work at NASA's Jet Propulsion Laborary where he now directs the de-velopment, analysis, and testing of preliminary hardware concepts for the post Mars 2020 sample return missions. In addition to his passion for space, Scott is an avid world traveler, cyclist, and urban hiker.