Title: Modeling and Simulation bring Deep Understandings of Device Drug Delivery to Improve Patient Experience

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Drug delivery devices and drug-device combination products involve complex working mechanisms, nonlinear materials with complex mechanical behaviors, and interactions between fluids and structures. The development and manufacturing of combination products entail deep understanding of the design, manufacturability, and reliability, where modeling and simulation offer unparalleled capabilities and complement testing based on physical prototypes. This presentation will provide a few case studies of device and combination products modeling at Abbvie.

Bio-compatible polymers including thermoplastic polyurethane and thermoplastic elastomer are commonly used in medical devices such as drug delivery tubing and connectors. They provide excellent durability and resistance against oils and chemicals. Their mechanical properties are complex, exhibiting nonlinear large strain nonlinearity, hysteresis, and permanent set under cyclic loading. Hi-fidelity finite element modeling was utilized to study the performance of delivery system under various conditions. Results showed high margin of safety.

Auto-injector is a combination of drug and device. A syringe pre-filled with drug is installed into a spring-loaded pen device to achieve automatic subcutaneous drug delivery. Finite element simulations of the firing/activation process provided deep insights about the working mechanism that were not known from prior experiments. Infusion pump is an electro-mechanical device used to deliver drug into human body at large volumes and over long period of time. Simulations showed working mechanism of the complex device that includes components made from nonlinear silicone rubber and thermoplastic polyurethane materials. Multiphysics modeling of auto-injector provided deep insights about the drug solution fluid flow driven by the device which were not easily measurable.

Biography

Nick Song has completed his PhD from The University of Missouri and his MBA from Purdue University. He is a technical manager of the Science & Technology organization at Abbvie Inc, where he leads the modeling and simulation of drug delivery devices and systems. He previously completed numerous technical consulting projects on drug delivery and medical devices with major medical companies, as a consultant at the world leading simulation solutions company Dassault Systemes (previously ABAQUS Inc.) He has published more than 20 papers in reputed journals and conferences.

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