Science and Technology

TRANSPORTATION SECURITY AND EXPLOSIVES CHARACTERIZATION

HIGH-FIDELITY EXPLOSIVE SIMULANT PRODUCTION

COMPUTER-ASSISTED DESIGN AND MANUFACTURING METHODS FOR HIGH-FIDELITY SIMULANTS

Researchers at the U.S. Department of Homeland Security Transportation Security Laboratory have developed a portfolio of technologies for designing and manufacturing high-fidelity explosive simulants that enable accurate mimicry of both the microscopic and macroscopic properties of target explosives. A computer-assisted design system allows users to select target compounds and rapidly iterate to optimize simulant composition to match multiple properties simultaneously. Manufacturing methods provide guidance to produce a suite of simulants with the appropriate microscopic and macroscopic properties that encompass solids and liquids in a variety of formats, including textured and nontextured bulk explosives, flexural sheets, and powders. The portfolio covers X-ray and millimeter wave active simulants. DHS has developed an ASTM-WK85823 to pair with these technologies to ensure all simulants created are accurate for each application. The combined technologies vastly improve upon manual trial-and-error methods to facilitate more-rapid design and to manufacture more-accurate simulants at both the macroscopic and microscopic levels across a broader range of target explosives.

KEY BENEFITS

+ Accelerates simulant development
+ Reduces simulant development costs
+ Facilitates more accurate simulant production
+ Applicable to multitude of explosives
+ Simulants safer than real explosives

STAGE OF DEVELOPMENT

Prototype

PARTNERSHIP SOUGHT

License

INVENTORS

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DHS COMPONENT

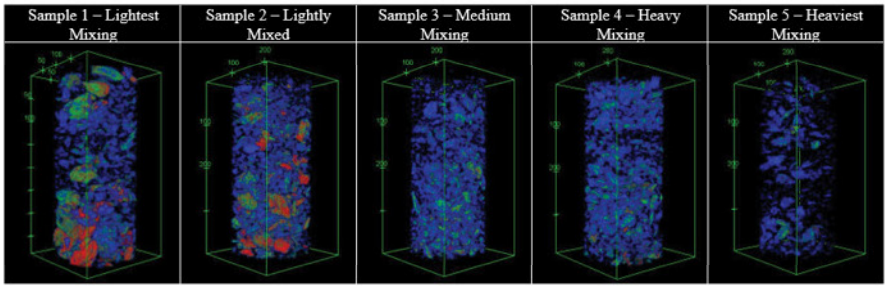
Science and Technology Directorate

The Technology Transfer and Commercialization Branch (T2C) within the Office of Industry Partnerships (OIP) of the Department of Homeland Security (DHS) Science and Technology Directorate (S&T) serves as the centralized point to manage technology transfer activities throughout DHS and the DHS laboratory network. **T2C@hq.dhs.gov**

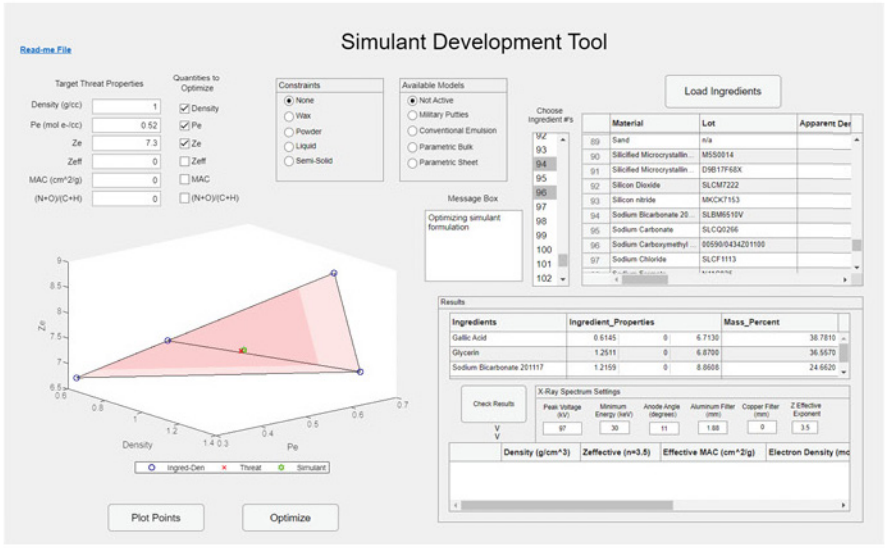
THE TECHNOLOGY

The computer-assisted simulant design system features a graphical user interface (GUI) and a proprietary database of target threat compounds and inert ingredients with key metrics like density, electron density, effective atomic number (Zeff), mass attenuation coefficient (MAC), chemical compound ratio, dielectric constant, and millimeter wave reflectivity. Users select the target threat, inert ingredients, and key metrics to match, and the system uses optimization algorithms to provide ingredient proportions for a simulant composition. The GUI also allows users to interact with a 3D output plot to refine the simulant composition by selecting alternative ingredients or changing proportions.

The simulant manufacture methods detail how to combine inert ingredients into X-ray or millimeter wave active mixtures. These methods include specific processing and formulaic procedures to vary macroscopic (e.g., tactile, texture, particle density, granularity, flexural modulus, bulk density, dielectric constant, millimeter wave reflectivity, crystal density, porosity) and microscopic (e.g., electron density, Zeff, MAC, chemical compound ratio) properties. Simulants like triacetone triperoxide (TATP), HMTD, PETN, and RDX have been developed leveraging these methods.



Illustrates five volumetric CT scans of textured simulants.



A screen shot of the GUI for the Simulant Development Tool.

APPLICATIONS

The technology has several potential end users:

+ **Explosive simulant development and manufacturing**
+ **Explosive detection specialist training**
+ **Explosive detection equipment testing**
+ **Explosive detection system R&D**

PATENT INFORMATION

US Patent Application numbers: 18/109,055, 18/109,007, and 16/230,042

US Patent numbers 11,114,183, 10,998,087, 11,613,504, 11,254,623, 10,941,085, and 8,563,316

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TECHNOLOGY SOLUTION

FOR MORE INFORMATION ABOUT THE DHS TECHNOLOGY TRANSFER & COMMERCIALIZATION BRANCH:

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