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**Self-similar Turbulent Vortex Rings: Interaction of Propellant Gases with Blood Backspatter and the Transport of Gunshot Residue**[1]
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Self-similar turbulent vortex rings are investigated theoretically in the framework of the semi-empirical turbulence theory for the modified Helmholtz equation. The velocity and vorticity fields are established, as well as the transport of passive admixture by turbulent vortex rings. Turbulent vortex rings of propellant gases originating from the muzzle of a gun after a gunshot are an important phenomenon to consider in crime scene reconstruction. It is shown that this has a significant repercussion on the outcome of backward blood spatter resulting from a gunshot. Turbulent vortex rings of propellant gases skew the distribution of blood stains on the ground and can either propel blood drops further from the target, or even turn them backwards toward the target. An image of the propagating muzzle gases after bullet ejection is overlaid with the predicted flow field which reveals satisfactory agreement. Gunshot residue is an important factor in determining the events of a violent crime due to a gunshot and are considered to be entrained and transported by the propellant gases. The self-similar solutions for the flow, vorticity, and concentration of gunpowder particles are predicted and the results are shown to be consistent with the experimental data.

[1]US National Institute of Justice (NIJ 2017- DN-BX-0171).

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