Objective: Develop an automated trailer coupling/decoupling system that can be integrated on to both current autonomous systems such as Expedited Leader Follower and Autonomous Ground Resupply, as well as Next Generation Autonomous Systems.

Description: Trailers provide the capability to increase throughput by transporting mission essential equipment and supplies including weapons systems, equipment, tactical power, water and ammunition. Connecting to trailers is an aggravating task, made more difficult by tough terrain and weather conditions. Developing/implementing an autonomous hitch can make a dangerous, time-consuming and manpower intensive task that can be done in a much shorter time period. This SBIR is looking for innovative ways to automate trailer coupling/decoupling. Ideally the system will be a simple installation onto the existing Military convoy vehicle fleet currently being utilized in various soldier tested autonomous convoy vehicle technology/capability demonstrations. Low-cost, high reliability sensors are critical for reliable autonomous hitch performance especially given the mission profiles experienced during autonomous convoy vehicle operations over rough terrain and high speeds.

This SBIR is linked to Ground Vehicle Robotics (GVR) Expedited Leader Follower (ExLF) and Autonomous Ground Resupply (AGR) Science and Technology Objective (STO) programs, providing additional autonomous vehicle capability to enhance vehicle autonomy operations to support automated convoy vehicle performance. ExLF and AGR are currently adding the capability to integrate trailers in forward and reverse directions as part of a semi-autonomous convoy. Adding the capability to autonomously couple and decouple a trailer will work to automate a dangerous, time consuming and manpower intensive task. The topic will implement innovative solutions to allow for a PLS vehicle to autonomously connect the pintle hitch and power/air/data lines of a M1076 trailer to fully automate trailer coupling/decoupling. There is an opportunity to demonstrate this capability as part of AGR Increment 3 Soldier experiment in FY21; ultimately transitioning the capability to inform the Leader Follower Program of Record.

Phase I: Determine the feasibility of an optimal autonomous trailer hitch sensor suite that can engage/disengage with an autonomous vehicle. Develop simplified soldier controls for activating/monitoring autonomous trailer hitch process/operations. Develop system that requires minimal base vehicle modification/installation. Conduct autonomous trailer hitch simulations with integrated virtual sensors to refine autonomous trailer hitch design/operation. Design hitch capable of 3-axis articulation to allow for non-exact vehicle/trailer alignment. Develop hitch capable of interfacing/supporting FMTV/PLS vehicles and able to support Gross Trailer Weight Rating of 3000lbs and Tongue Weight Rating of 3,000lbs. Generate a technical report documenting above analysis/evaluation/integration of autonomous trailer hitch capability.

Phase II: Create a prototype of autonomous trailer hitch system and evaluate in relevant scenarios/applications on representative base vehicles. Integrate optimal autonomous trailer hitch sensors identified/evaluated in Phase I on a representative base vehicle. Conduct autonomous trailer hitch testing throughout a variety of vehicle configurations/conditions and reevaluate/confirm previously selected optimal sensors. Optimize autonomous trailer hitch system with regards to performance, cost, reliability, ease of integration, etc. Incorporate a pintle that is moveable both laterally and longitudinally to permit a single operator to hook-up to a M1076 PLS trailer. Hook-up shall be with the trailer tongue offset laterally up to 12 to 18 inches from the centerline of the truck and 12 to 18 inches aft of the towing position. The pintle shall be capable of towing all lunette style trailers in common use with 2-1/2, 5, and 10 ton vehicles.

Phase III Dual-Use Applications: Transition autonomous trailer hitch system onto current/future targeted Military autonomous systems, including Expedient Leader-Follower/AGR, etc. Transition system into commercial market segments that would benefit or are currently utilizing trailers during normal operations, such as recreational vehicles, tractors, semi-trailers, etc.

References:
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3. freepatentsonline.com/2016/0243908.html