Drivetrain Comparison and Selection Approach for Armored Wheeled Hybrid Vehicles

Authors : Çağrı Bekir Baysal, Göktuğ Burak Çalık

Abstract : Armored vehicles may have different traction layouts as a result of terrain capabilities and mobility needs. Two main categories of layouts can be separated as wheeled and tracked. Tracked vehicles have superior off-road capabilities but what they gain on terrain performance they lose on mobility front. Wheeled vehicles on the other hand do not have as good terrain capabilities as tracked vehicles but they have superior mobility capabilities such as top speed, range and agility with respect to tracked vehicles. Conventional armored vehicles employ a diesel ICE as main power source. In these vehicles ICE is mechanically connected to the powertrain. This determines the ICE rpm as a result of speed and torque requested by the driver. ICE efficiency changes drastically with torque and speed required and conventional vehicles suffer in terms of fuel consumption because of this. Hybrid electric vehicles employ at least one electric motor in order to improve fuel efficiency. There are different types of hybrid vehicles but main types are Series Hybrid, Parallel Hybrid and Series-Parallel Hybrid. These vehicles introduce an electric motor for traction and also can have a generator electric motor for range extending purposes. Having an electric motor as the traction power source brings the flexibility of either using the ICE as an alternative traction source while it is in efficient range or completely separating the ICE from traction and using it solely considering efficiency. Hybrid configurations have additional advantages for armored vehicles in addition to fuel efficiency. Heat signature, silent operation and prolonged stationary missions can be possible with the help of the high-power battery pack that will be present in the vehicle for hybrid drivetrain. Because of the reasons explained, hybrid armored vehicles are becoming a target area for military and also for vehicle suppliers. In order to have a better idea and starting point when starting a hybrid armored vehicle design, hybrid drivetrain configuration has to be selected after performing a trade-off study. This study has to include vehicle mobility simulations, integration level, vehicle level and performance level criteria. In this study different hybrid traction configurations possible for an 8x8 vehicle is compared using above mentioned criteria set. In order to compare hybrid traction configurations ease of application, cost, weight advantage, reliability, maintainability, redundancy and performance criteria have been used. Performance criteria points have been defined with the help of vehicle simulations and tests. Results of these simulations and tests also help determining required tractive power for an armored vehicle including conditions like trench and obstacle crossing, gradient climb. With the method explained in this study, each configuration is assigned a point for each criterion. This way, correct configuration can be selected objectively for every application. Also, key aspects of armored vehicles, mine protection and ballistic protection will be considered for hybrid configurations. Results are expected to vary for different types of vehicles but it is observed that having longitudinal differential locking capability improves mobility and having high motor count increases complexity in general.

Keywords : armored vehicles, electric drivetrain, electric mobility, hybrid vehicles
Conference Title : ICHEV 2023 : International Conference on Hybrid and Electric Vehicles
Conference Location : Lisbon, Portugal
Conference Dates : October 30-31, 2023

Open Science Index, Transport and Vehicle Engineering Vol:17, No:10, 2023 publications.waset.org/abstracts/163826.pdf