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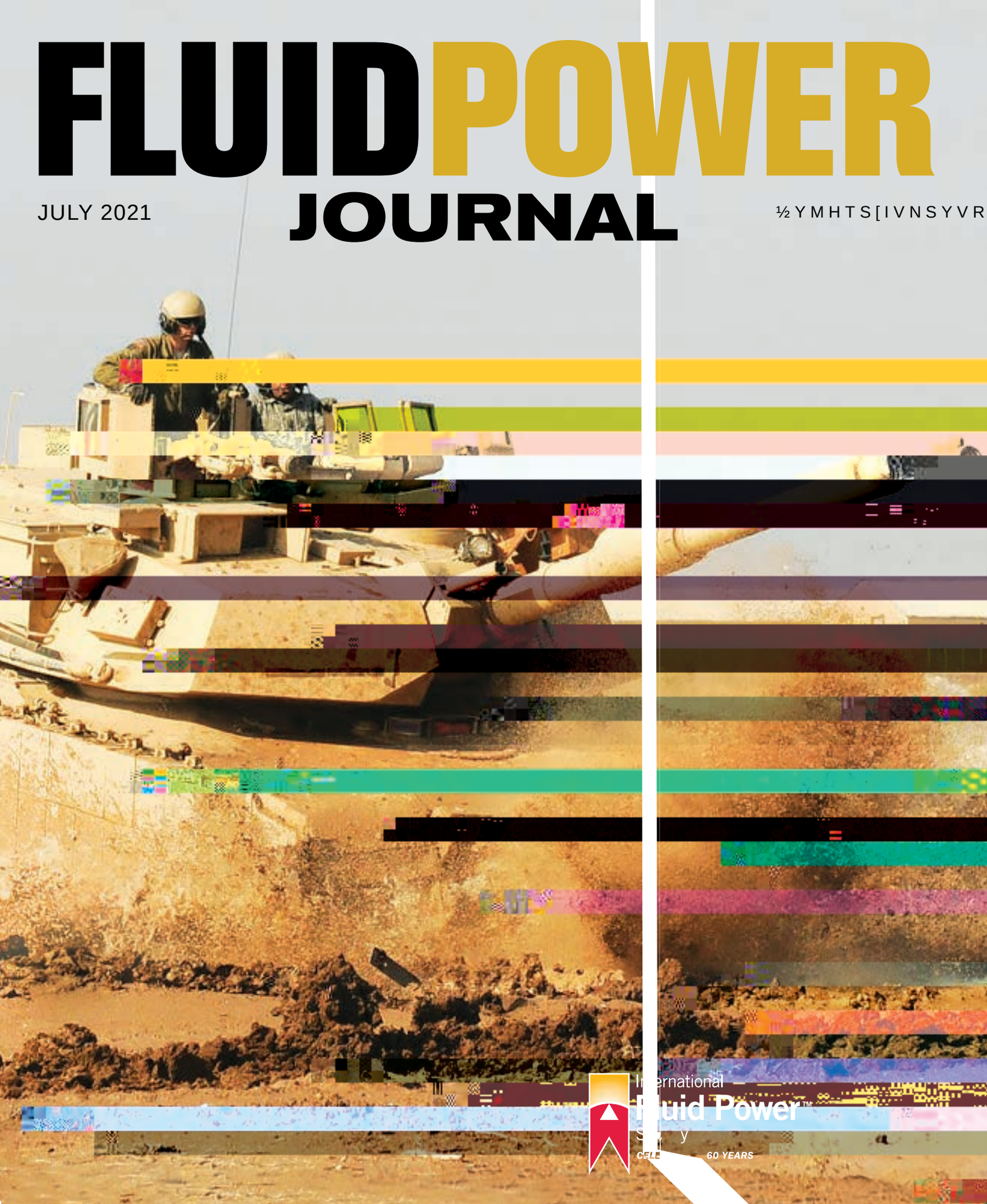
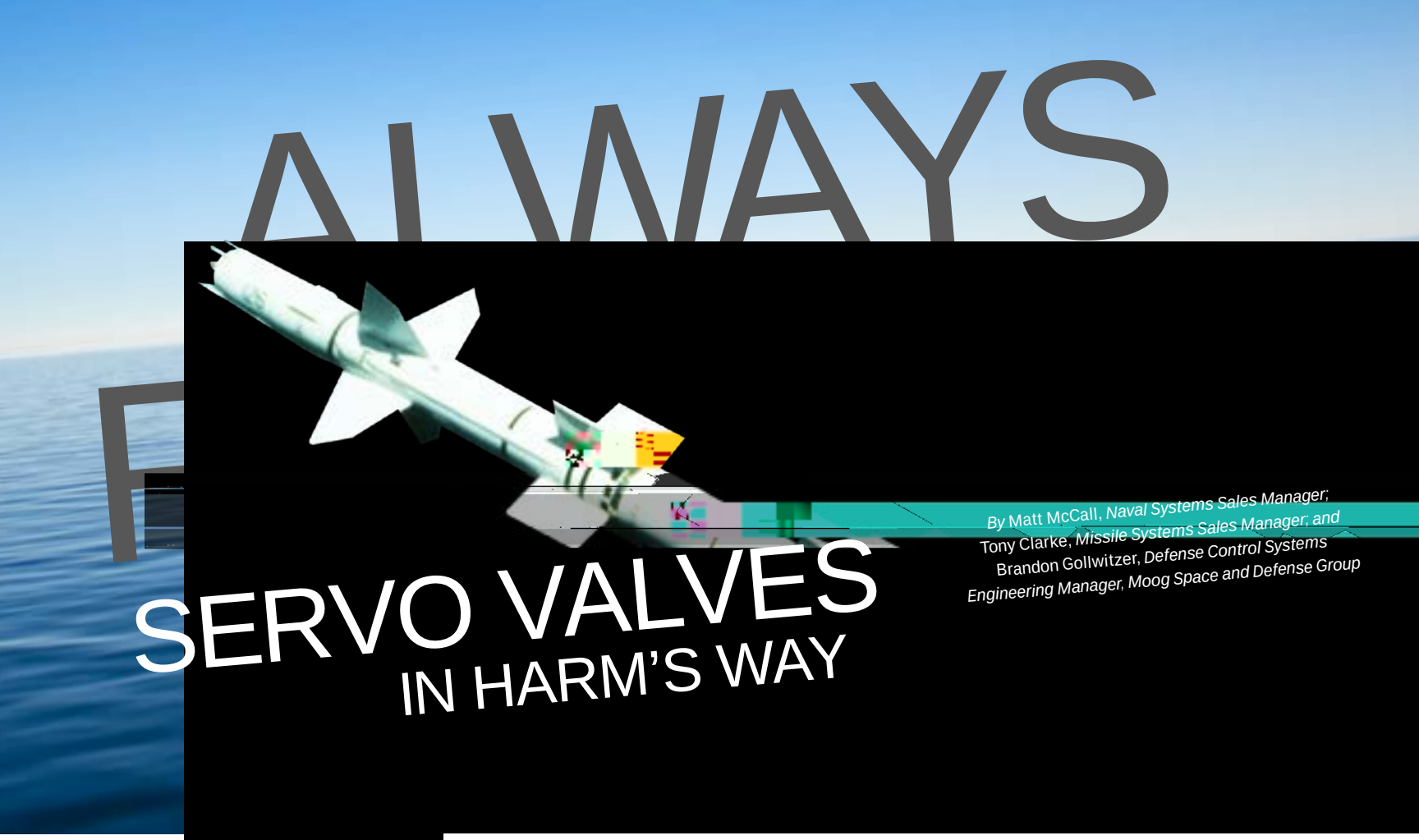


International Fluid Power Society

CELEBRATING 60 YEARS



SERVO VALVES IN HARM'S WAY

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The nozzle/flapper servo valve was invented and developed by Bill Moog shortly after World War II and was quickly incorporated into military applications. invshoreliab19.9yano Tc -c361 -5 ( )ol[(D/TT3 1 Tf339.0005.0001 [(shor)-8W)j 0developecompon(y s ha2 Tc9.8 m0

Missile family. In the 1950s, the newly developed servo valve unlocked the ability to accurately position a control surface under high loads with fast dynamic response, all inside the small tail section of a fast-moving missile. As control actuation needs evolved and missiles continuously grew smaller, pneumatic actuation became widely used. This is largely because the actuation media – gas – can be dramatically compressed into high-pressure reservoirs, reducing the size and weight of the power source for the actuation system. Pneumatics are well-suited for single-use actuation or short-duration proportional control. The drive for longer flight times, among other requirements, pushed missile steering control toward EM actuation systems. As electrical power storage capabilities improved, EM actuation systems became a viable missile steering control methodology.

In recent years, the maturation of additive manufacturing capabilities has affected the trade between hydraulic, pneumatic, and electric control actuation solutions. Additively manufactured components naturally align with hydraulic systems, as flow paths for the fluids can be dramatically optimized when compared to traditional subtractively machined designs. This manufacturing capability allows hydraulic solutions, along with their servo valve "brains," to be integrated into almost any envelope or configuration, as the additive manufacturing design can effectively use whatever space is available inside a volume-constrained missile.

With heritage applications and new opportunities unlocked by complementary technology, servo valves remain relevant to the missile-steering market today. Moog is actively manufacturing and delivering servo valves to provide proportional steering control to missile control surfaces on various platforms around the world. Servo valves represent a mature and well-understood solution in the control-systems

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capability in modern military fighting vehicles. Servo valves keep turreted weapons on target while the vehicle is traversing rough terrain and reacting to the recoil caused by firing the cannon. Hydraulic drives are the solution of choice for large-caliber platforms like main battle tanks and mobile artillery, and Moog servo valves are at the heart of those systems. These turrets, often wielding barrels with bore diameters ranging from 120 to 155 mm (5 to 6 inches), require the power density and high bandwidth of Moog servo valves to achieve performance under often high unbalanced loads.

Missile-launching platforms differ from turreted weapons in that they typically execute their mission from a stationary position. As a result, missile launchers rarely require stabilized motion control. The job for these servo valves is to move a launcher payload weighing several tons from rest at one position to rest at the farthest extreme in a matter of a few seconds. This application requires high rates of acceleration and hydraulic braking, which are profiled carefully to meet the mission objective without overturning the platform or damaging sensitive equipment.

Ground-based warfighters benefit from

Photo by Spc. Hubert D. Delany III, courtesy U.S. Army

However, those new capabilities come at a cost to the performance of the hydraulic drive systems because they have to overcome the increased weight and inertia of the system. In these cases, servo valves employed in conjunction with increased system pressure restore and even increase performance beyond the original design points. These cost-effective modernization efforts allow technology insertion to the current force and extend the service life of the platforms. z