configuration, equipment variations, or workpiece geometric variations). Resultantly, controlling the standoff distance indirectly based on the voltage measurements introduces standoff distance errors that cumulatively add up over workpiece layers, thereby negatively affecting workpiece quality.

SUMMARY

[6a] In an aspect, the present disclosure refers to a directed energy deposition additive manufacturing system comprising: a controller comprising a logic, a standoff distance measurement unit, a substrate, a plasma torch, a feed unit, a material, and a mover, wherein logic causes the feed unit to output the material and the plasma torch to output a plasma such that the plasma melts the material onto the substrate and a workpiece is thereby additively manufactured on the substrate, wherein the workpiece has a geometric profile, wherein the plasma torch is vertically spaced apart from the workpiece such that a standoff distance is defined, wherein the logic causes the standoff distance measurement unit to monitor the geometric profile while the workpiece is being additively manufactured such that the logic causes the mover to move at least one of the plasma torch relative to the substrate or the substrate relative to the plasma torch in order to maintain the standoff distance.

[6b] In another aspect, the present disclosure refers to a method for additive manufacturing, the method comprising: outputting a material; outputting a plasma via a plasma torch; melting the material via the plasma such that a workpiece is additively manufactured on a substrate, wherein the workpiece has a geometric profile, wherein the plasma torch is vertically spaced apart from the workpiece such that a standoff distance is defined; monitoring the geometric profile while the workpiece is being additively manufactured such that a mover can move at least one of the plasma torch relative to the substrate or the substrate relative to the plasma torch in order to maintain the standoff distance

[7] Accordingly, disclosed herein are various technologies for directed energy deposition (e.g. RPD^{TM}) additive manufacturing systems that enable standoff distance monitoring and control, which can be responsive, dynamic, and/or in real-time. These technologies can use a standoff distance measurement system, such as a laser triangulation system or a laser line scanner (LLS), to real-time monitor, read, or interrogate a workpiece (e.g. bead profile, workpiece shape) or a substrate on which the workpiece is positioned, as

the workpiece is moved (e.g. via substrate) past a directed energy source (e.g. plasma torch), or vice versa. Note that other optical measurement techniques, such as time of flight, confocal, chromatic confocal, interferometry, shape from shading, depth from focus/defocus, Lidar, alone or in combination with illuminations, such as fringe projection, pattern projection (e.g. line, multi-line, multi-spot) of different wavelengths, such as infrared, visible, UV, X-Ray, and non-optical methods, such as sonar, ultrasonic readers or interrogators, can be supplementally or alternatively used to real-time monitor, read, or interrogate the workpiece (e.g. bead profile, workpiece shape) or the substrate on which the workpiece is positioned, as the workpiece is moved (e.g. via substrate) past the directed energy source (e.g. plasma torch), or vice versa. These technologies can use a feedback controller to responsively and dynamically control the standoff distance (e.g. raise or lower directed energy source relative to workpiece or vice versa) in real-time based on data from the standoff distance measurement system, such as the laser triangulation system or the laser line scanner (although other optical measurement techniques, such as time of flight, confocal, chromatic confocal, interferometry, shape from shading, depth from focus/defocus, Lidar, alone or in combination with illuminations, such as fringe projection, pattern projection (e.g. line, multi-line, multi-spot) of different wavelengths, such as infrared, visible, UV, X-Ray, and non-optical methods, such as sonar, ultrasonic readers or interrogators, can be supplementally or alternatively used. Therefore, these technologies eliminate at least some technical limitations associated with an industry standard of using voltage-