Assessment of particle size and shape for bound metal powders using digital image analysis

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Abstract:
The accurate measurement of particle size and shape distributions are critical to many powder metallurgical processes. These metrics have a strong influence on powder flowability, packing, compressibility, and many other factors that affect densification behavior and the overall performance of sintered components. The particle size of loose powders is easily measured using various standard techniques (e.g., laser diffraction and sieve analysis). However, these approaches cannot quantify size distributions in bound particulates, commonly used for powder injection molding or material extrusion additive manufacturing. This study discusses the efficacy of image-based techniques for assessing the particle sizes and distributions of bound metal powders. Improvements in image acquisition and analysis can help to improve particle sampling and create a reliable assessment of particle size distributions. However, there are still significant challenges in accurately assessing the size and shape of three-dimensional particles with two-dimensional image-based techniques.

Introduction:
Additive manufacturing processes are revolutionizing industrial practice for prototyping and low volume production [1]. In particular, material extrusion additive manufacturing (MEAM) has a strong potential for disrupting manufacturing industries, particularly in producing engineering-grade metal alloy components [2,3]. One of the most critical features of any powder metallurgical process is the characterization and control of feedstock materials. In MEAM, the accurate characterization of feedstock powders is vital for understanding and controlling critical aspects of printing and sintering to create a high-quality product [4]. Crucial particle characteristics include the size and shape distributions, which directly affect powder flowability, packing, and rheology during metal injection molding (MIM)