Additive manufacturing of components for a ball machine prototype

Nicolae Tunsoiu[1], Cristian-Vasile Doicin[2], Ion Murzac[3], Teofil-Alin Oncescu[4], Daniela Tunsoiu[5], Roman Murzac[6], Mihaela-Elena Ulmeanu[7,*]

[1]*University POLITEHNICA of Bucharest, Department of Manufacturing Engineering, Splaiul Independentei 313, Bucharest, Romania, nicolae.tunsoiu@upb.ro*

[2]*University POLITEHNICA of Bucharest, Department of Manufacturing Engineering, Splaiul Independentei 313, Bucharest, Romania, cristian.doicin@upb.ro*

[3]*University POLITEHNICA of Bucharest, Department of Mechanisms and Robots Theory, Splaiul Independentei 313, Bucharest, Romania, ion.murzac@upb.ro*

[4]*University of Craiova, Department of Applied Mechanics, Calea Bucuresti 107, Craiova, Romania, alin.oncescu93@gmail.com*

[5]*University POLITEHNICA of Bucharest, Department of Manufacturing Engineering, Splaiul Independentei 313, Bucharest, Romania, daniela.citu@upb.ro*

[6]*University POLITEHNICA of Bucharest, Department of Manufacturing Engineering, Splaiul Independentei 313, Bucharest, Romania, roman.murzac@upb.ro*

[7]*University POLITEHNICA of Bucharest, Department of Manufacturing Engineering, Splaiul Independentei 313, Bucharest, Romania, mihaela.ulmeanu@upb.ro*

Keywords: Additive manufacturing, design for additive manufacturing, robotics, sport

Abstract: Sports have become an important part of most people's lives. Every performance athlete goes through a series of workouts with different sports equipment meant to help their physical condition. In football, a player must perform countless shots to practice training techniques. Thus, the development of automated sports equipment that can throw a ball with a specific pre-set speed and trajectory is necessary to facilitate the work of the coach. The paper presents the additive manufacturing process of components for a ball machine prototype used for training athletes. Each component was studied, and the best manufacturing technology was selected in correspondence with the general and specific functions of the prototype, and considering technological restrictions set in place by the manufacturing facility. Most of the components in the product's power system were made by additive manufacturing, this choice being conditioned by the appearance of innovative, customized component elements, used in the drive system. Material extrusion was used due to the custom shapes and sizes, specific to the developed product, which innovatively influence the principle of hitting the ball. Fusion 360 was used to design all components, taking into consideration material extrusion technological requirements and design principles. A basic static finite element analysis was performed on the main paddle component to ensure that it could withstand the stress scenario and the results showed that when using HIPS filament, the limit conditions are fully met. CAD files were saved as *.STL files and introduced in Z-Suite software for parameter optimisation according to the functional role of each component. The optimised *.ZCODEX files were sent to Zortrax M300* machines for material extrusion 3D printing of the components. The final result is a functional prototype of a device that was obtained using mainly additive manufacturing.