An artificial neural network model for additively manufacturing of NiTiHf alloy

Mehrshad Mehrpouya[a,b]*, Annamaria Gisario[b], Mohammadreza Nematollahi[c], Atabak Rahimzadeh[b], Mohammad Elahinia[c]

[a] Dipartimento di Ingegneria, Università degli Studi Roma Tre, Via Vito Volterra 62, 00146 Roma, Italy
[b] Dipartimento di Ingegneria Meccanica ed Aerospaziali, Sapienza Università degli Studi di Roma, Via Eudossiana 18, 00184 Rome, Italy
[c] Mechanical, Industrial, and Manufacturing Engineering Department, The University of Toledo, Toledo, OH, USA

Abstract:

Shape memory alloys (SMAs) have particular thermo-mechanical properties, including superelasticity and shape memory effect, which can be applied in various applications. However, high-temperature shape memory alloys (HTSMAs) have introduced a new class of SMAs with higher transformation temperatures (over 120 °C) that can be used in aerospace or petroleum industries. Among HTSMAs, NiTiHf alloys are the most common option due to their superior functional and mechanical behavior. Additive manufacturing process creates an opportunity for fabrication of complex shapes and geometries. In this study, NiTiHf samples are fabricated by selective laser melting printer using various operational parameters. Obviously, controlling the process parameters, namely laser power, laser scan speed, and hatch spacing, have a considerable impact on the properties of the final 3D printed parts. Accordingly, the input parameters can remarkably change the thermo-mechanical properties such as samples width, density, and transformation temperature. This paper develops an artificial neural network (ANN) model, as a prediction tool, to achieve the optimum operational parameters in the AM process. In fact, the ANN model is able to find the relationship between variables which can learn and predict based on the experimental data.

Keywords: Modeling; Artificial Neural Network; Additive Manufacturing; NiTiHf; High-temperature Shape Memory Alloys