Localized Heat Assisted Incremental Forming of Polycarbonate Sheets by Tool Rotation

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Abstract. During the last decade, incremental sheet forming has represented one of the most attractive processes for various reasons, like easy automation, flexibility of manufacturing customized products and low production cost. In particular, this technique, born for the production of metal parts in fields like automotive and aeronautic, has gained increasing attention when applied to thermoplastic materials, due to their very interesting structural and thermal properties. At the same time, further research is required to deepen the knowledge related to the forming of these outstanding engineering materials. In this regard, the aim of this work is to investigate a hot incremental sheet forming process for the manufacturing of polycarbonate sheets. In particular, the present process provides a localized and controlled heating by means of the contact of the sheet with a rotating tool and, then, constitutes a viable way to preserve the flexible nature of this technology. A clamping frame for single point incremental forming of square sheets, 2 mm thick polycarbonate sheets, forming tools with two different shapes and a thermal camera for polymers were used for this study. A preliminary experimental campaign consisted of straight groove tests on the sheets to get an idea of the influence of the shape and the rotation speed of the tool on the sheet heating, in order to reach temperatures that do not compromise the surface quality of the polymeric sheets. In view of the results of these tests, fixed wall angle square pyramid frusta were manufactured by setting a unidirectional spiral toolpath, with and without the localized heating. The results, in terms of surface and geometrical quality of the components, were analysed, in order to individuate the potential of the process under exam.