Acoustic emission-based in-process monitoring of surface generation in robot-assisted polishing - DTU Orbit (21/04/2019)

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The applicability of acoustic emission (AE) measurements for in-process monitoring of surface generation in the robot-assisted polishing (RAP) was investigated. Surface roughness measurements require interruption of the process, proper surface cleaning and measurements that sometimes necessitate removal of the part from the machine tool. In this study, stabilisation of surface roughness during polishing rotational symmetric surfaces by the RAP process was monitored by AE measurements. An AE sensor was placed on a polishing arm in direct contact with a bonded abrasive polishing tool, and a cylindrical workpiece in Vanadis 4E steel was polished in 40 polishing passes from an initial turned surface roughness $Ra = 3.1 \mu m$ down to $Ra = 0.07 \mu m$. The polishing task was performed in five intervals and after 4, 8, 20, 30 and 40 passes, the resulting surface roughness was measured. The results show a decreasing trend in measured AE signal power and RMS, which is well qualitatively correlated with the development of surface roughness during polishing.

The trend allows the identification of an asymptote representing the process completion (stabilisation of surface roughness), reliable for correct in-process determination of the process endpoint. This makes it possible to reliably determine the right time for changing the polishing media to finer abrasive when applying a given set of parameters is no longer effective to create a smoother surface, thus improving the efficiency of the process. The findings enabling automatic detection of optimal process endpoint allow intelligent process control, creating fundamental elements in development of robust fully automated RAP process for its widespread industrial application.

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