Development of a multisensory arm for process monitoring in Robot Assisted Polishing

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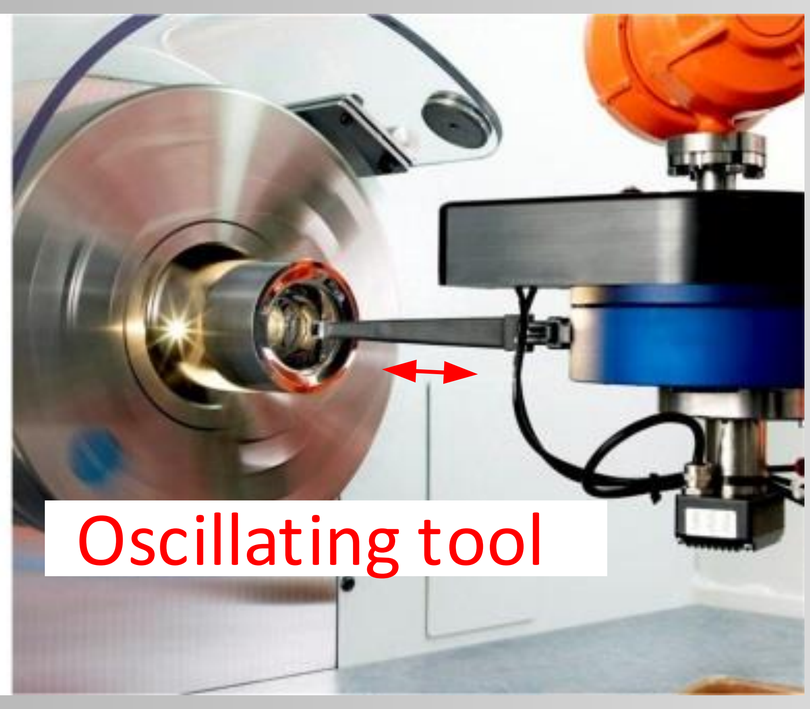
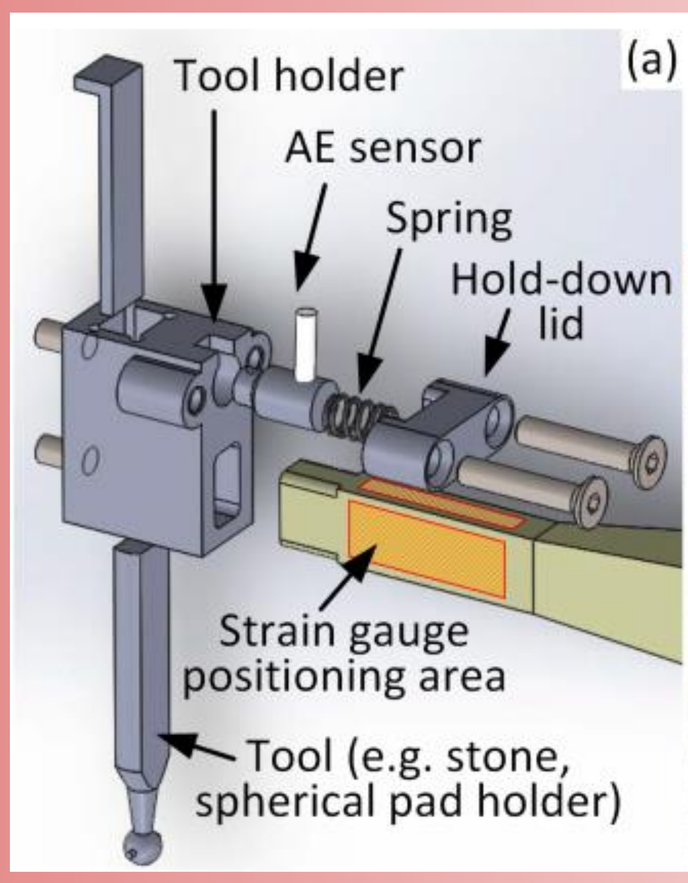


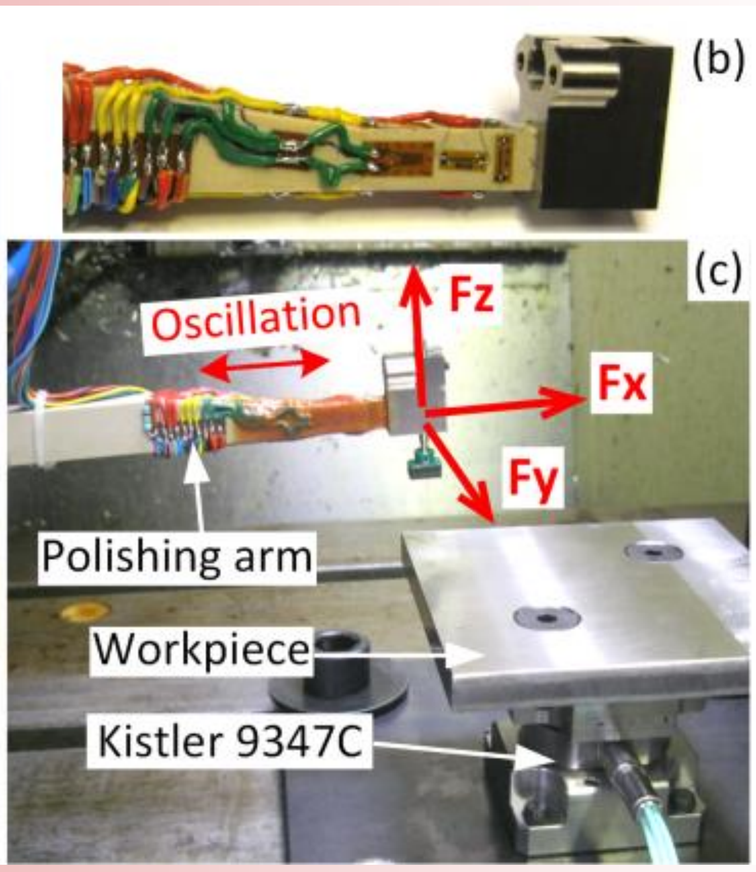
Robot Assisted Polishing (RAP) process is capable of achieving surface roughness down to *Sa* 10 nm on industrial components. In RAP, a robot arm carries a polishing module with controlled contact force utilizing oscillating or rotating tools.

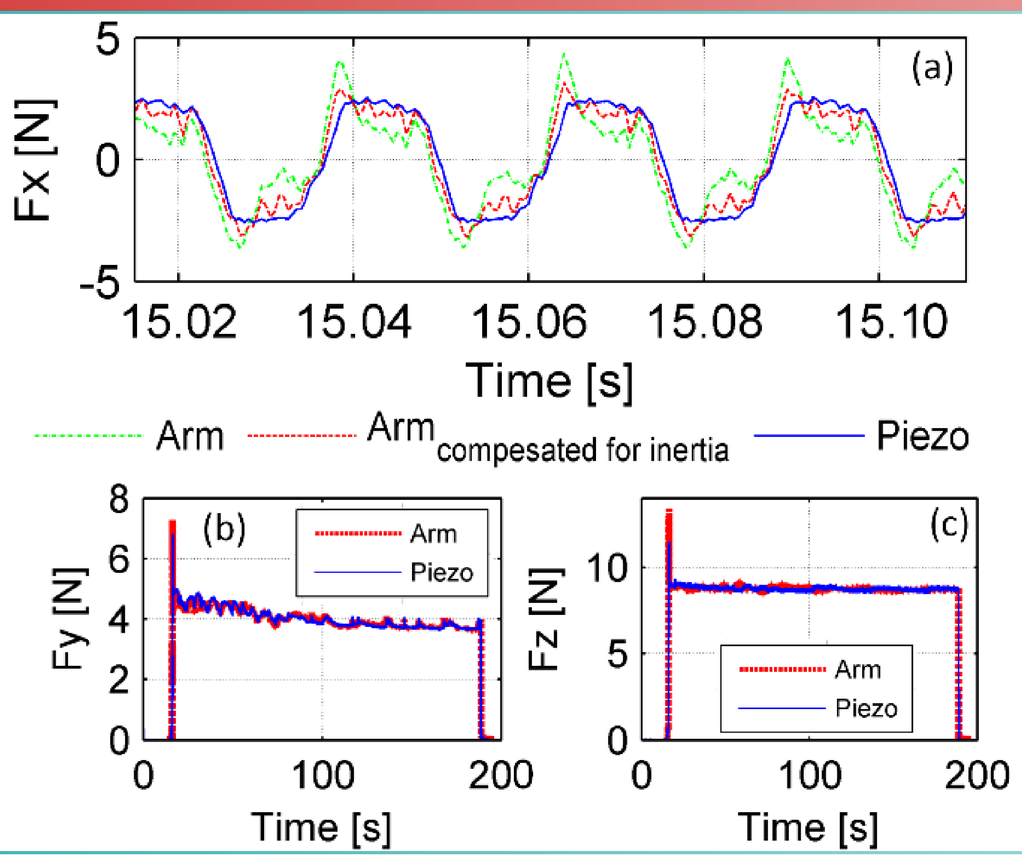
In this work a multisensory polishing arm with integrated Acoustic Emission (AE), accelerometer and force sensors was developed and the reliability of force measurements for process monitoring in RAP was verified.

The developed and optimized arm design with three axial force sensor (*Fx*, *Fy*, *Fz*) consists of semiconductor and metallic strain gauges, miniature AE sensor and an accelerometer (a).

The manufactured force sensor (b) was calibrated by means of static application of defined loads. The sensor performance in a dynamic application was subsequently verified in a number of tests by comparison of the measured interaction forces with a reference calibrated piezoelectric dynamometer from KISTLER (c).







At high oscillation frequencies of the arm, *Fx* force is affected by the inertia due to the mass of the oscillating arm (a - green dashed). Such measurement bias can be effectively corrected by measurement of acceleration, calculation and subtraction of the inertial force component from the measurements (a - red dashed), in comparison to the reference piezoelectric force measurement (a – blue solid). An average measurement error of 1 % in paste polishing and 4 % in stone polishing was observed for the investigated process settings.

The results have demonstrated reliable trends in the signals measured by the arm (a, b, c) fundamental for the intended process control to be based on the relative change in friction forces, presumably reflecting the change in surface topography during polishing.

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