Stability of simultaneous turning processes

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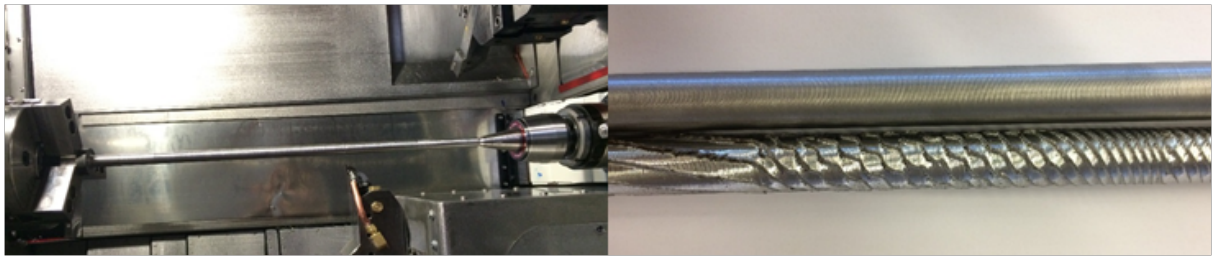
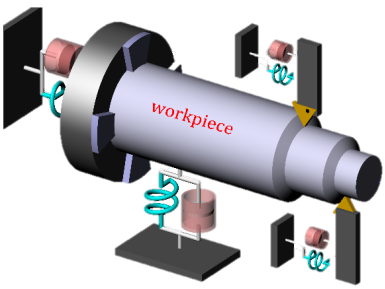
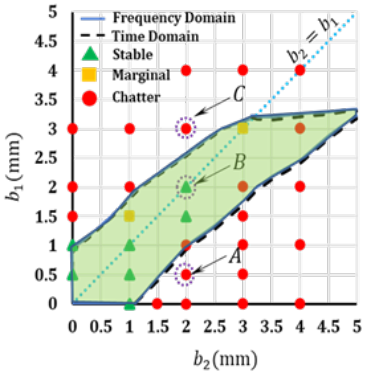
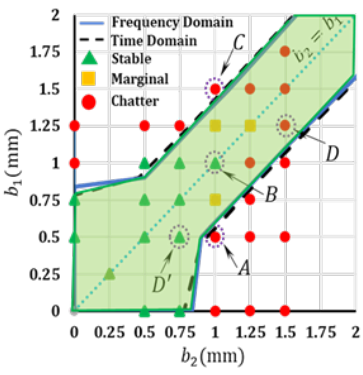
Simultaneous turning with extra cutting edges increases the material removal rate (MRR), and thus the productivity of the process. On one hand, chatter could be a fatal threat to the productivity and part quality in simultaneous turning operations of slender and flexible workpieces. On the other hand, stability of flexible part turning can be increased significantly if the process parameters are selected properly. In practice, however, ensuring a stable parallel turning of a flexible workpiece is approached by the costly process of trial and error. In order to tackle this problem, a multi-dimensional model for chatter stability analysis of parallel turning operation is presented where the effects of components' dynamics, i.e. workpiece and cutters, in addition to insert's geometry are accounted for. The stability model is formulated for two configurations of the parallel turning operation in frequency and time domains, and verified experimentally. These two configurations are for cutters machining the same and different surfaces on the part during a simultaneous turning operation. The characteristic equations involving dynamic interactions among process forces from both tools and structures are solved in frequency domain to obtain stability maps which show stable and unstable depth pairs for both tools. Frequency domain solutions are verified by time-domain solutions and experiments. Finally, chatter-free and high productivity cutting conditions are determined through optimal parameter selection employing stability maps generated for each configuration.









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