

Dynamic Designer Motion and induDrive: An example of how to develop Cam Curves in Mechanical Desktop

When calculating interactive motions, it is often desired to receive detailed information - at the initial stage already and parallel to designing - about the behaviour of the machine (e.g. speeds, collisions, etc.).

In the Mechanical Desktop (MDT), detailed geometric information with all masses, moments of inertia, etc. are made available. By the interaction of Dynamic Designer and induDrive, motions can be precisely controlled free from shocks and jerks, and curves can be optimized.

The procedure follows three steps:

At the earliest time possible, the tool motions are harmonized - a task that can possibly be executed during the initial planning period already as, at this stage, a detailed elaboration of the individual parts is not required.

In the second step, the design including all levers and joint rods, etc. up to the cam roller is completed. The movement of the roller centre is followed up in relation to the revolving drive shaft. Departing from the centre path, the cam disc is generated. Finally, the kinematics are "reversed" again, so that the machine is driven via the contour of the cam discs. All the forces in all the joints can now be checked, the drives and other elements (e.g. springs) can be arranged.

In the present example, two simultaneously running movements for a bottle filling plant shall be generated. The movements must allow the collision-free immersion of the red filling rod into a bottle (see Fig. 1).

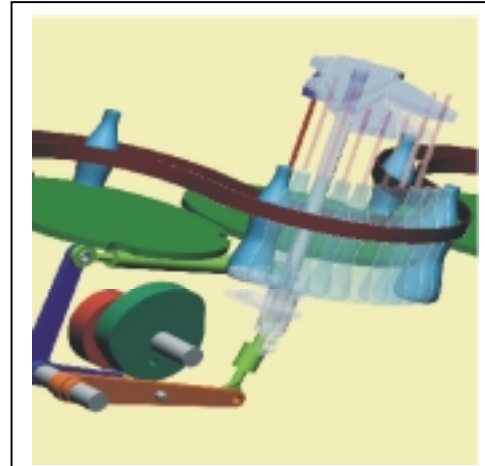


Fig. 1: Overall view on the filling plant

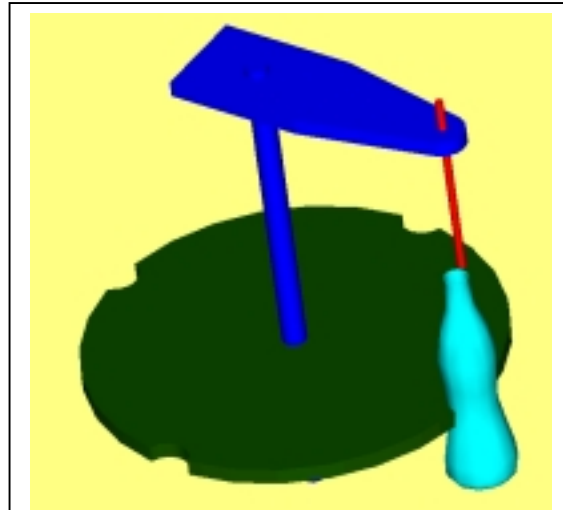


Fig. 2: Harmonization of the motions right at the initial stage of the design process

Motion harmonization

The starting position of the motion sequence is known: It is a turning-reversing position of the filling rod (see Fig. 2). At this stage, the situation presents itself as follows: The bottle disc with the bottle has already reached a constant speed

(here: 45 degrees/sec.). The filling rod has a zero speed, its acceleration is not yet known (reversing situation).

Therefore, to begin with, the filling rod must be accelerated until it has reached the turning speed of the disc. At this time it must be positioned accurately above the bottle. Only then it may immerse (at constant revolving speed). It will rest in the lowest position for some time, then it will retract from the bottle and swing back again.

These motion sections are defined in induDrive (see Fig. 3). The operator selects one of the motion functions. The limiting values are as far as possible calculated automatically by the program and conferred to the following motion section. This way, even users without practice are in a position to define motion sequences quickly. The single movements are calculated following the input, and the functional curves are graphically displayed with their derivations. All values can be directly called up in the graphics. Unfavourable motion sequences (swinging over, for instance) are immediately recognized and can be changed interactively (see Fig. 4).

For a theoretical view on the complete procedure, the movements can also be displayed in a common graphic. In Fig. 5 it can be clearly seen that a chronological overlapping of the motion sections for turning and vertical movement were entered (see Fig. 2, Derivation).

With induDrive, any number of drives can be calculated simultaneously.

#	z	f	Behavior	f' Beg	f' End	f'' Beg	f'' End	f''' Beg	f''' End	Lambda
0	0	0	Poly5	x	x	550	x	n/A	n/A	x
1	0,2	6	Linear	n/A	n/A	n/A	n/A	n/A	n/A	n/A
2	1,2	51	Poly5	x	x	x	x	n/A	n/A	x
3	1,4	57	Poly5	x	x	x	550	x	n/A	x
4	2	0	END	n/A	n/A	n/A	n/A	n/A	n/A	n/A

Fig. 3: Input of the motional functions into induDrive by sections

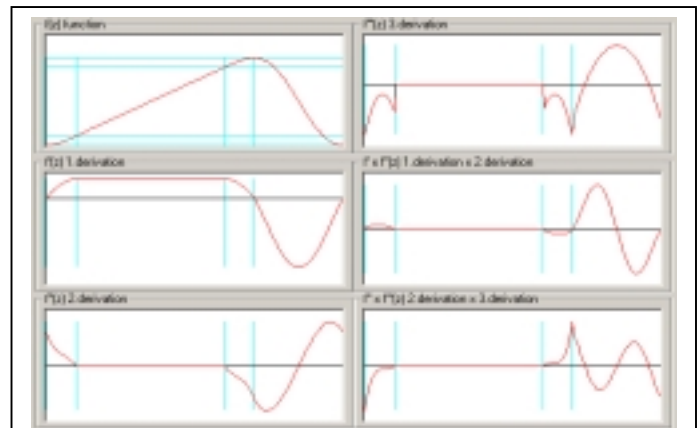


Fig. 4: Graphic analysis in induDrive

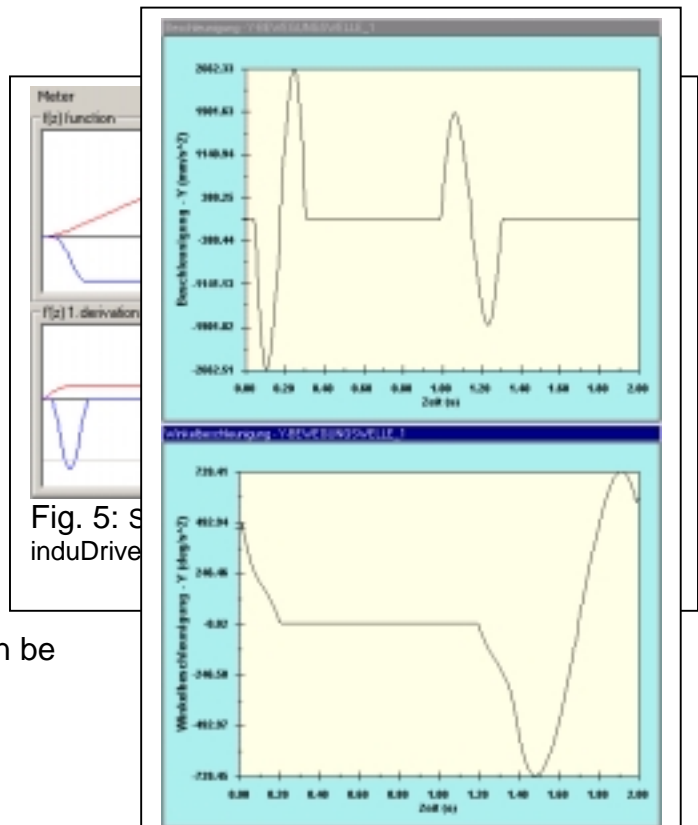


Fig. 5: s induDrive

Fig. 6: Analysis of the absolute acceleration in the Dynamic Designer

To this purpose, the drives generated by induDrive are cancelled and the rollers directly connected to the cam disc (contact joint in the DDM). The kinematics are now operating in the correct direction. Since all masses and moments of inertia are known to the system, the forces occurring in all the joints can be measured. Furthermore, a final check of the motion sequence can be undertaken, this time with the real contour in the model.

At the end, the springs for tensioning the roller levers to the cam disc must be lined out. The intermitting contact joint makes it possible to verify whether the roller loses contact with the cam at the given speed.

Summary

By an example for bottle filling it is demonstrated how cam drives can be quickly and comfortably arranged and optimized with the interaction of the programs Mechanical Desktop, Dynamic Designer and induDrive. The calculation of the cam contour is based on tool motion specifications. The dynamic behaviour of the design unit can be checked by means of the cam contour generated.

Where to buy

InduDrive is compatible with all versions of Dynamic Designer, and with ADAMS. You can obtain induDrive in German or English language from your local Dynamic Designer dealer, directly at MDI, or at

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