DEVELOPMENT OF A FLEXIBLE AUTOMATIZED SYSTEM FOR LIVESTOCK PROCESSING

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Designing robotized complexes is possible on the basis of a formalized description of a processing object, in our case these are live animals as well as carcasses after slaughtering. In Russia pigs to be processed substantially differ in their weight, size and fatness with fat-type animals prevailing. Studies were carried out aimed at the determination of a range of pig parameters changes for their subsequent classification, selection of animal groups and finding some reference points in carcass surfaces to be acceptable for the orientation of a tool.
Automation and mechanization of livestock slaughtering are bound up with the development of flexible automatized control systems which integrate robots, manipulators, robototechnical systems and computers.
As a basis for the control of robotized operations on pigs slaughtering the conception of a topological model of an animal which determines geometrical coordinates of a carcass (external and internal ones) and its individual areas from the results of processing of the statistical information data on carcass overall size and relative position of its those areas which are typical for carrying out individual technological operations (the distance from chest to clod, from snout to clod and hooking point) was assumed.
Processing of the statistical information data on animals geometry and weight involved the determination of zones to be correlated and connections from technological points to control measurements and reference points. A procedure reduced to testing the data uniformity and repeatability on an information retrieval volume, calculations of statistical characteristics and correlation coefficients for disclosing groups of parameters to be correlated and their ratios along measuring axes accepted.
The information data on parameter measurements of 175 pigs of the same breed was processed. While processing, random information retrievals with a volume of 30-35 values were studied with a view to determine the data uniformity, the latter having been determined by Kochren´s criterion in an overall information volume under study.

The analysis of the statistical data (in pigs) showed that variances and root-mean-square deviations of coordinates of reference points of carcass geometry within the limits of permissible displacements of an operating tool were observed only in case of the same animal breed, weight and age. In view of these factors the following information data on an animal carcass was systematized in the database /1/:
- weight;
- age;
- body length;
- chest girth;
- withers height;
- chest depth;
- chest width;
- length of flank;
- distance from girth line to clod;
- distance from girth line to snout;
- distance from clod to sticking point;
- distance between legs moved apart;
- distance from clod to an extremity moved out;
- metacarpal diameter under fetlock joint;
- distance from tail root to snout;
- distance from hooking point to snout.

Calculations of statistical characteristics and correlation coefficients showed that within the limits of the same animal breed, weight and age size ratios along each of three measuring axes proved to be practically constant and were characterized by the greatest values of correlation coefficients. Hence, for each group of animals a standard topological model was constructed as a data file representing a population of averaged geometrical sizes and reference points in carcass surfaces and cuts within the definite orientation system.
Visually (on display or in the printed-out form) this topological model was represented as topographo-anatomical maps of carcass cuts and sections projections for the different animal breeds and age groups. Three-dimensional coordinates of the different carcass points and areas of a standard animal can be determined accurate to a subinterval by splitting maps above-mentioned with a coordinate grid with a subinterval "P". A population of such maps enables to determine on three coordinates the position of individual anatomical points as well as organs in interconnection with a surface topology of animal body.
However, every concrete carcass entering the conveyor has its specific overall size and topology (both superficial and internal) which differ from an averaged standard topolo-

gical model of an animal. Therefore, for more precise defenition of coordinates of key anatomical and technological points the correction of a standard model is necessary which can be performed by proceeding from the constancy of correlations of sizes along each measurig coordinate and overall size of concrete carcass /1/.
On the basis of studies carried out a functional scheme of robotized slaughtering of pigs with pointing out engineering facilities and geometry of cuts as well as an automatized system for structure retrieving and identifying parameters of stochastic models were developed.

References

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