

Robotic challenges in non-invasive sampling of biomarkers

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There are big opportunities for enhancing the welfare of dairy cows using selective sampling of biomarker material. In order to be cost effective such a sampling should be done automatically based on an intelligent selection procedure. The development of a robotic system that is capable of sampling saliva, sweat and hair from dairy cows standing in an automatic milking stall is an interesting challenge from a roboticists point of view as the setup challenges the ordinary 'robot in a cage' paradigm. This is an entirely novel application of robotics, and in principle none of the operations are technologically demanding, but in practice any real world robotic application that involves interaction with an animal requires a combination of skills and pose new and interesting challenges. All components and the overall design in the prototype robotic system should be able to handle variety in the animals such as variety in size, height, shape and color. Handling this is often done using a sensor based control approach combined with passive or active compliance in the actuator and doing movements at low speeds. The sensors used could be cameras, laser scanners and/or simple distance measurement devices controlled by a real-time controller. The design of the operations of the system should be done in cooperation with animal scientists. Several ideas are considered, for instance, to obtain a saliva sample the robot might be programmed to dust a sponge with feed powder and then offer the sponge to the cow, withdrawing it after it had been in the mouth briefly. To obtain a sweat sample the robot would apply an absorbent heated sweat-collection patch and then recover the patch at the next milking. To obtain a hair sample the robot would operate a set of clippers together with a vacuum line. The basic idea is to use a Commercial-off-the-shelf (COTS) robot arm and COTS components as actuators and sensors. The hardware for mounting the robot on the automatic milking stall and the sample delivery system could be designed specifically for this application along with the control and interface software needed.

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