CURRENT UNIVERSITY AND USDA LAB COTTON CONTAMINATION RESEARCH

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Abstract

U.S. cotton is considered to have some of the lowest levels of contamination in the world. However, that reputation is in jeopardy as complaints of contamination from domestic and foreign mills are on the rise. Cotton contamination can be classified under four major categories: fabrics and strings from plastics and natural fibers, oils and chemicals, organic matter, and inorganic matter. Of particular concern are plastic contaminants – plastic trash that collects in cotton fields, black plastic film used as mulch in fields, plastic twine typically used for hay baling, and yellow plastic film used for round module wrap. So far in 2017, more than 1500 samples were classed with a plastic contamination call; only 25 samples were so classed in 2016. Currently, there are several Cotton Incorporated and National Cotton Council supported collaborative research efforts at the USDA ginning laboratories in Lubbock, Mesilla Park, and Stoneville, the USDA cotton quality lab in New Orleans, and at Texas A&M, Oklahoma State University, and the University of North Texas. The efforts target different points in the cotton production scheme from the field, to the harvester, to the module, and to the gin and focus on detection using imaging/optical characteristics and separation using physical/electrostatic characteristics.

Preventing plastic contamination from entering the cotton stream is the first priority in maintaining contamination-free U.S. cotton. Ongoing research at the Lubbock USDA Ginning Laboratory is investigating harvester-mounted cameras to detect contamination in the field and warn the operator before it enters the harvester and ends up in the module (Figure 1). Another research effort gearing up this year at Oklahoma State University will look at using unmanned aerial vehicles or drones mounted with cameras to fly over the cotton field and detect and record the location of contaminants (Figure 2). These coordinates can then be transmitted to the cotton producer's smart phone and located manually or an autonomous land vehicle can be dispatched to retrieve the plastics prior to harvesting. The researchers at Oklahoma State have already had success with the system on a project to reduce red cedar on Oklahoma pastureland.

When plastic contaminants do slip into the module or in the case where round module wrap is not completely removed, research efforts on detection methods at the cotton gin are underway. At Texas A&M University, a color camera system is being developed for viewing the backside of the module feeder cylinders to detect plastic wrapped on the spikes or pieces that slip through (Figure 3). The USDA Ginning Laboratories at Lubbock and Mesilla Park are testing and refining a prototype system to detect colored contaminants in seed cotton in places where the flow is slower and more spread out, like in rectangular ducts between cylinder cleaners and stick machines (Figure 4). University of North Texas researchers are using lasers to detect plastics in seed cotton at the gin stand feeder apron (Figure 5). This method capitalizes on the difference in how cotton and plastics scatter the reflected laser light. Though late in the gin process stream, the feeder apron has the advantage of presenting a thin, near single-locked, flow of cotton.

If detection is successful, plastic contaminants will need to be separated or extracted from the cotton. Early work evaluating current gin machinery at the USDA Ginning Laboratory in Stoneville showed that about 17% of plastics that enter the gin end up in the bale. There is research underway to modify current machinery to more effectively remove plastics. Also, extraction methods using air to fluff the cotton and float lighter contaminants away are under investigation in Mesilla Park (Figure 6). Plastics can acquire a much larger and opposite polarity static change than cotton. This difference causes the plastics and cotton to be attracted to opposite charges when exposed to a high voltage electric field. It is anticipated that this behavior can be used to develop a kind of "plastic magnet" that will encourage the lighter plastics to move away from the seed cotton.

The USDA and university researchers and scientists working on these projects are committed to finding solutions to the current cotton contamination problem, helping the U.S. cotton industry to maintain its low contamination reputation.

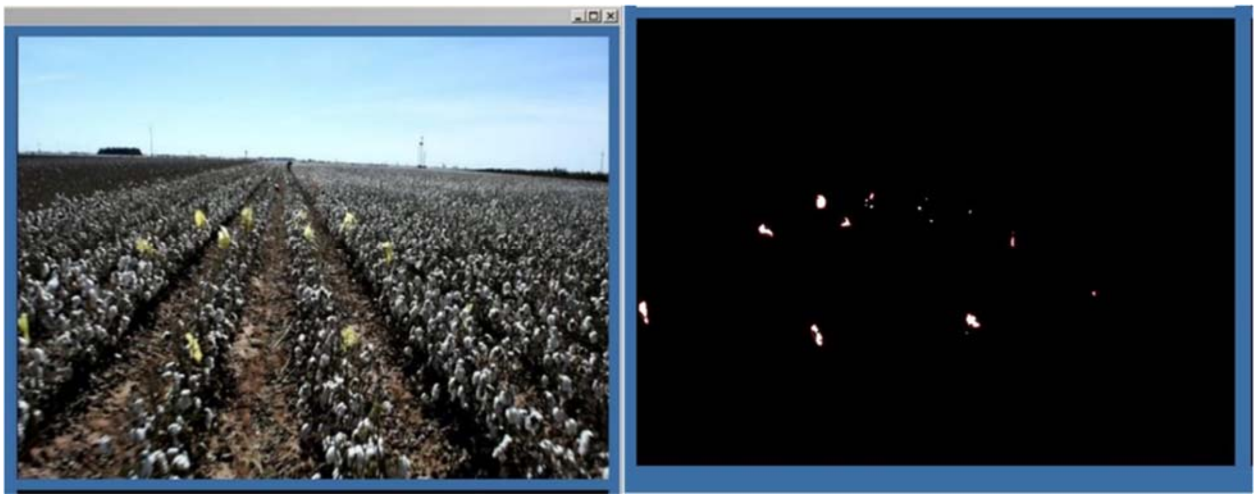

Figure 1. Harvester mounted camera in-field plastic detection: cotton field "spiked" with yellow plastic (left) and computer processed image with plastics identified (right).

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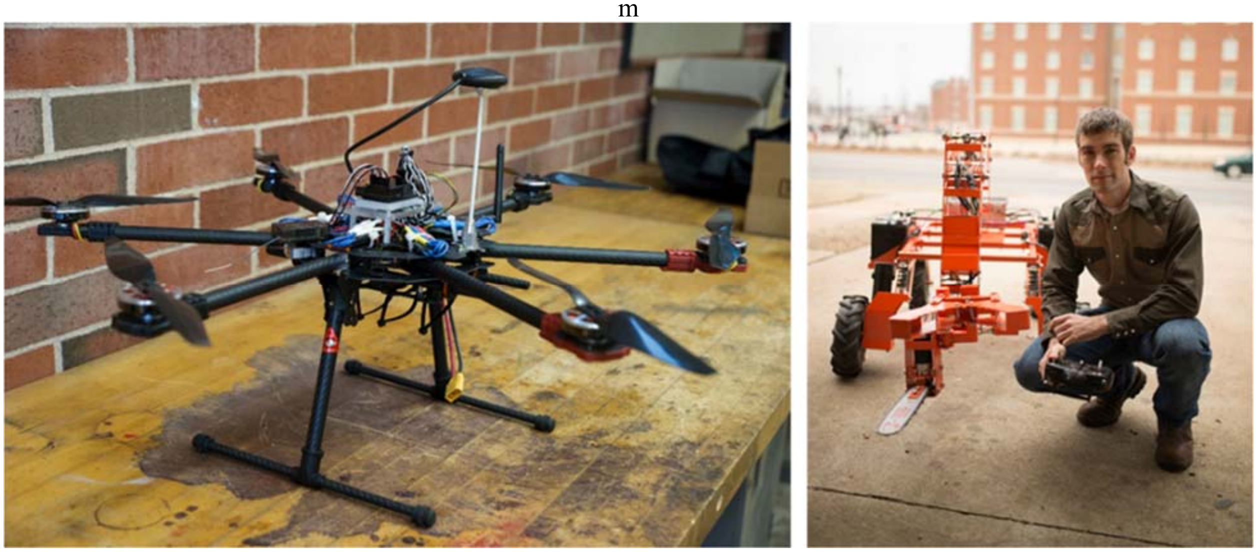

Figure 2. Prototype Oklahoma State University drone and autonomous robot.

Figure 3. Module wrap detected at the module feeder.

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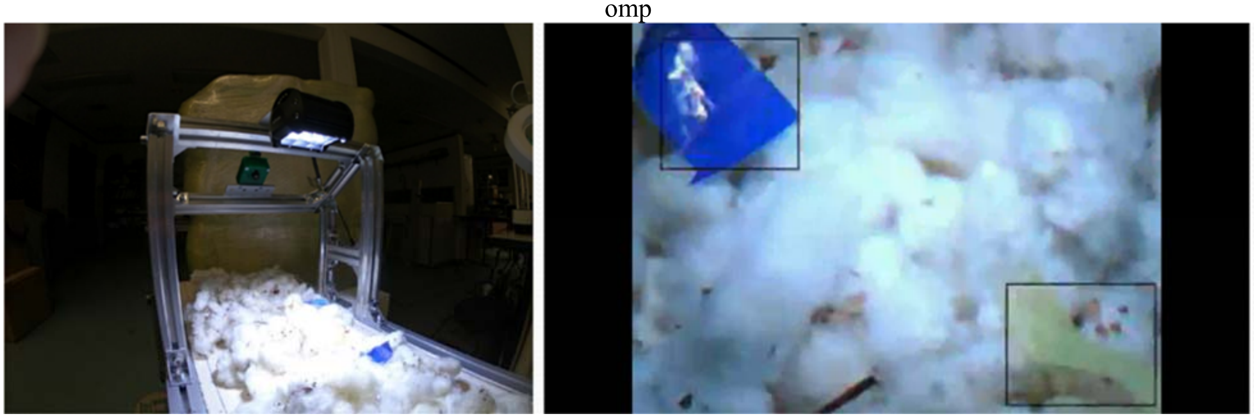

Figure 4. In-gin colored plastic detection system

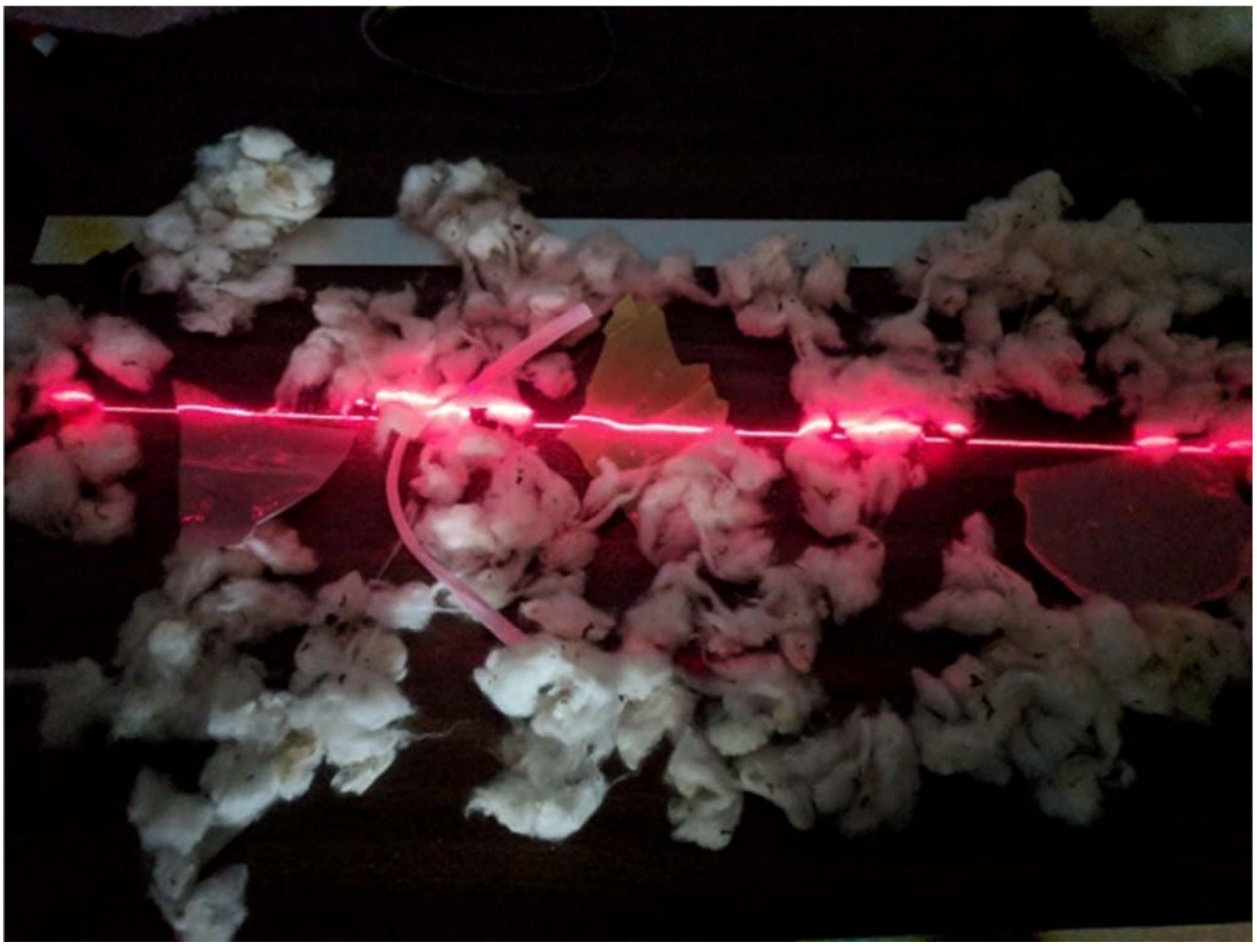

Figure 5. Laser scattering properties of seed-cotton compared to plastics that yield a much finer line.

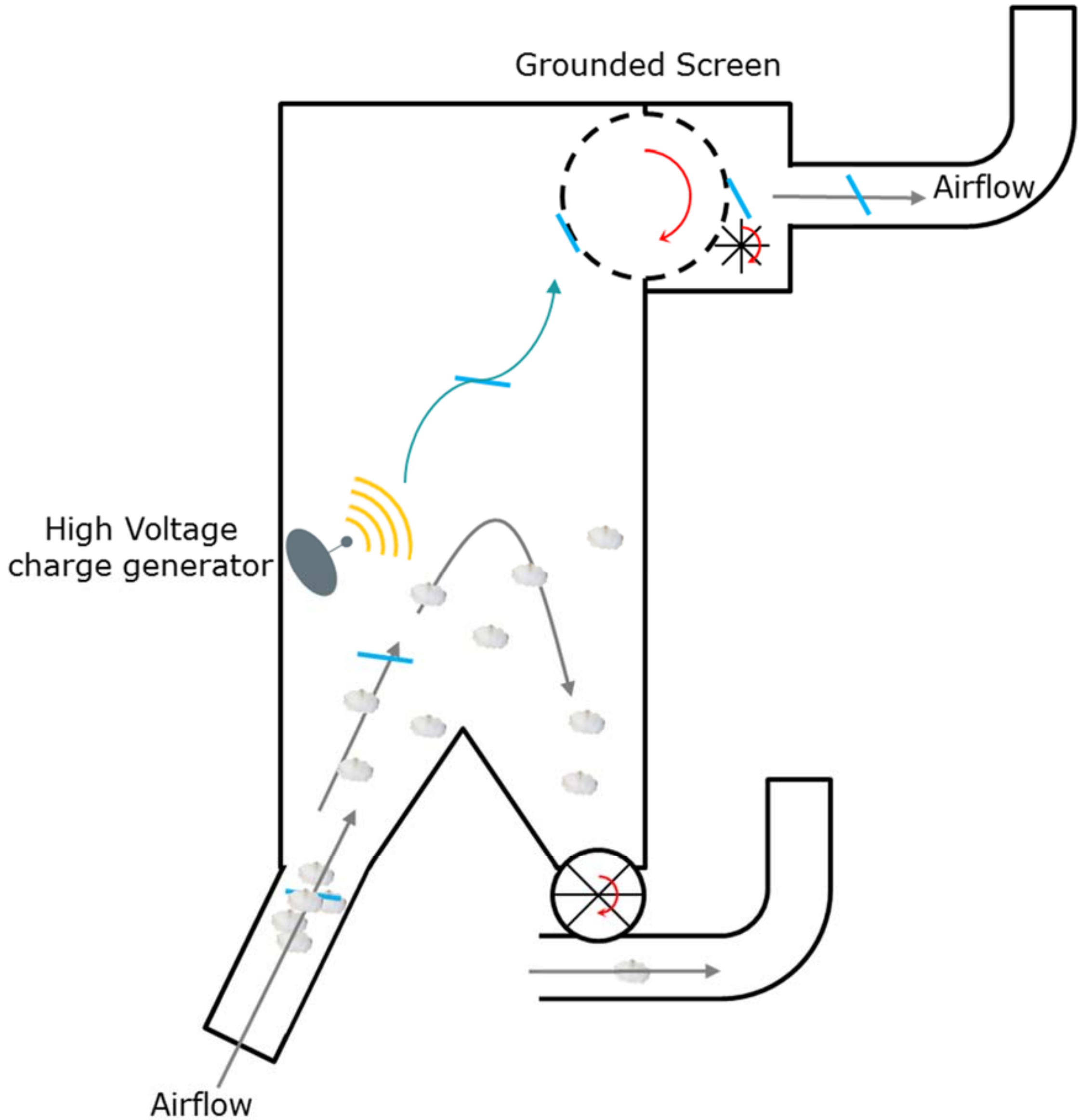

Figure 6. Concept incorporating a technique to release plastics from cotton by "fluffing" and move plastics out of the cotton stream with airflow enhanced by a high voltage electric field.