

ceive and respond to the sensor data, or controlling the flow of the sensor data.

The UAV control system provides (1) external connections to flight sensors, (2) the computational resources neces-

sary to make flight decisions, and (3) a simple interface through which control can be exerted over the servomotors that actuate the flight-control mechanisms of the UAV.

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## Biomimetic/Optical Sensors for Detecting Bacterial Species

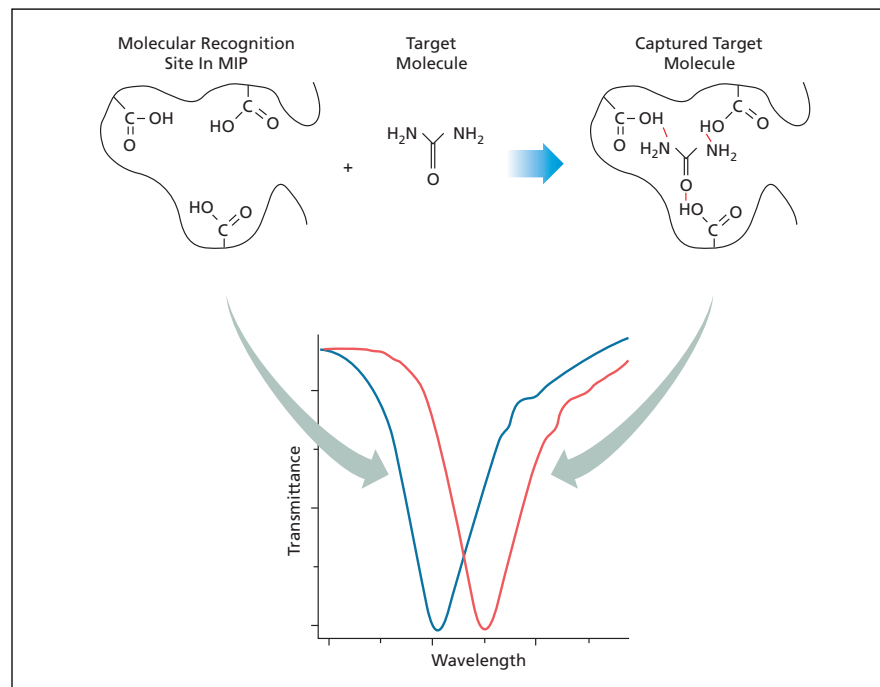
### Bacteria in liquid samples could be detected in real time.

NASA's Jet Propulsion Laboratory, Pasadena, California

Biomimetic/optical sensors have been proposed as means of real-time detection of bacteria in liquid samples through real-time detection of compounds secreted by the bacteria. Bacterial species of interest would be identified through detection of signaling compounds unique to those species. The best-characterized examples of quorum-signaling compounds are acyl-homoserine lactones and peptides. Each compound, secreted by each bacterium of an affected species, serves as a signal to other bacteria of the same species to engage in a collective behavior when the population density of that species reaches a threshold level analogous to a quorum.

A sensor according to the proposal would include a specially formulated biomimetic film, made of a molecularly imprinted polymer (MIP), that would respond optically to the signaling compound of interest. The MIP film would be integrated directly onto an optical-waveguide-based ring resonator for optical readout. Optically, the sensor would resemble the one described in "Chemical Sensors Based on Optical Ring Resonators" (NPO-40601), *NASA Tech Briefs*, Vol. 29, No. 10 (October 2005), page 32.

MIPs have been used before as molecular-recognition compounds, though not in the manner of the present proposal. Molecular imprinting is an approach to making molecularly selective cavities in a polymer matrix. These cavities function much as enzyme receptor sites: the chemical functionality and shape of a cavity in the polymer matrix cause the cavity to bind to specific molecules. An MIP matrix is made by polymerizing monomers in the presence of the compound of interest (template molecule). The polymer forms around the template. After the polymer solidifies, the template molecules are removed from the polymer matrix by decomplexing them from their binding sites and then dissolving



**Capture of Target Molecules** at molecular recognition sites in an MIP film would cause a change in the wavelength of an optical resonance. The change would be proportional to the concentration of bacteria that secreted the target molecules.

them, leaving cavities that are matched to the template molecules in size, shape, and chemical functionality. The cavities thus become molecular-recognition sites that bind only to molecules matched to the sites; other molecules are excluded.

In a sensor according to the proposal, the MIP would feature molecular recognition sites that would bind the specific signaling molecules selectively according to their size, shape, and chemical functionality (see figure). As the film took up the signaling molecules in the molecular recognition sites, the index of refraction and thickness of the film would change, causing a wavelength shift of the peak of the resonance spectrum. It has been estimated that by measuring this wavelength shift, it should be possible to detect as little as 10 picomoles of a

peptide signaling compound.

*This work was done by Margie Homer, Alexander Ksendzov, Shiao-Pin Yen, and Margaret Ryan of Caltech and Beth Lazazzera of the University of California, Los Angeles, for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).*

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