Power-aware Fusion of Visual and Wheel Odometry for Mobile Platform

Mateusz Malinowski[12], Arthur Richards[1], Mark Woods[2]
[1]University of Bristol, Bristol BS8 1QU; [2]SCISYS UK Ltd., 23 Clothier Road, Bristol BS4 5SS

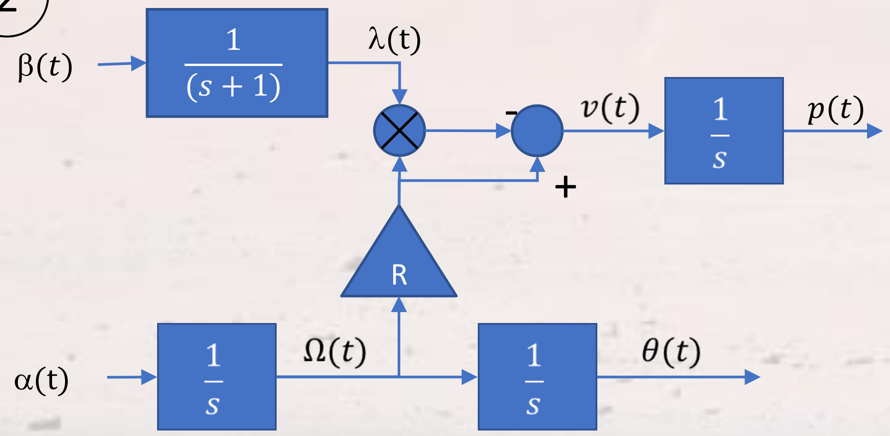
SCISYS is now part of CGI

University of BRISTOL

1 Given a typical localisation mode on a Mars rover…

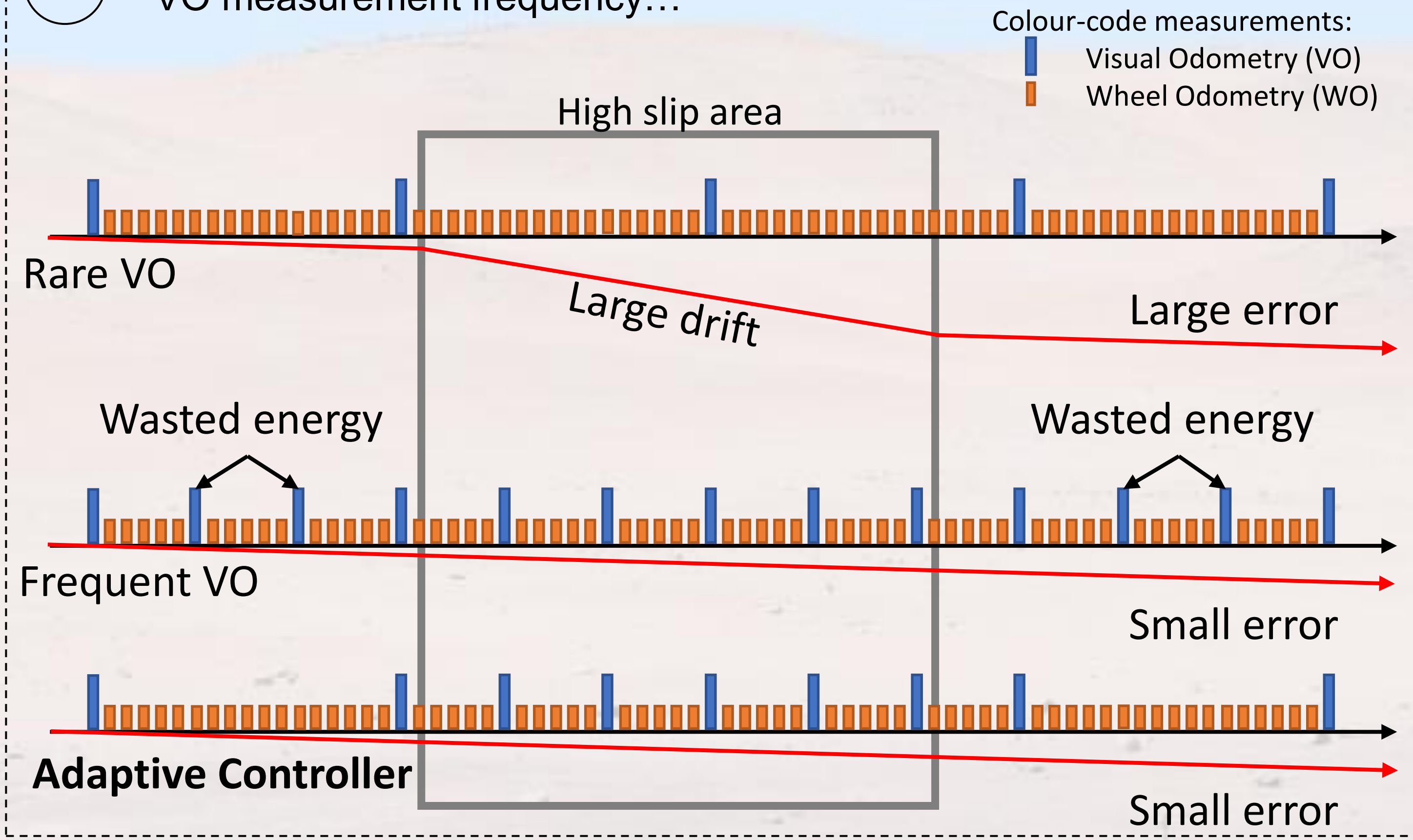
	Measurement Frequency	Energy Cost	Localisation Accuracy	Requires to stop?	Prone to slip?
Wheel Odometry (WO)	High	Low	Low	No	Yes
Visual Odometry (VO)	Low	High	High	Yes	No

2 …let's define a model for an adaptive filter…



State vector	$x(t) = [p(t)\ \theta(t)\ \Omega(t)\ \lambda(t)\ m(t)]^T$
Augmented state variable	$m(t^+) = \begin{cases} p(t) & \text{if VO measurement at time t} \\ m(t) & \text{otherwise} \end{cases}$
WO measurement	$y_{WO}(t) = \theta(t) + \varepsilon_{WO}(t)$
VO measurement	$y_{VO}(t) = p(t) - m(t) + \varepsilon_{VO}(t)$
Slip definition	$\lambda(t) = 1 - v(t)/[R*\Omega(t)]$

3 …which would use slip (λ) estimate to control VO measurement frequency…



4 …to operate more efficiently:

- Less frequent VO on no slip ground = less energy used (fewer image acquisitions, fewer stops, fewer executions of complex algorithm)
- More frequent VO in slip areas = maintain low position estimation error

This research was funded by SCISYS UK Ltd., now part of CGI Inc.