Altimetry Using GPS-Reflection/Occultation Interferometry

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A Global Positioning System (GPS)-reflection/occul
tion interferometry was examined as a means of altimetry of 
water and ice surfaces in polar regions. In GPS-reflection/ 
occlusion interferometry, a GPS receiver aboard a satellite 
in a low orbit around the Earth is used to determine the temporally varying 
carrier-phase delay between (1) one com-
ponent of a signal from a GPS transmitter 
propagating directly through the 
atmosphere just as the GPS transmitter 
falls below the horizon and (2) another 
component of the same signal, propa-
gating along a slightly different path, re-
lected at glancing incidence upon the 
water or ice surface.

The integer-cycle phase-difference 
ambiguity is resolved by noting that 
both signal components eventually col-
lapse into a single component, repre-
senting zero phase difference. From 
the phase difference and the known po-
sitions of the two spacecraft as func-
tions of time, an atmospheric correc-
tion obtained as the main data product 
of the GPS-receiver mission, and basic 
geometry, the difference in length be-
tween the direct and reflection signal 
paths and the altitude of the effective 
specular-reflection point can be calcu-
lated. This method yields altitude at 
about 0.7-m precision with horizontal 
resolution of a few kilometers.

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Thermally Driven Josephson Effect

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A concept is proposed of the ther-
merically driven Josephson effect in super-
uid helium. Heretofore, the Josephson 
effect in a superfluid has been recog-
nized as an oscillatory flow that arises in 
response to a steady pressure difference 
between two superfluid reservoirs sepa-
rated by an array of submicron-sized ori-
ces, which act in unison as a single 
Josephson junction. Analogously, the 
thermally driven Josephson effect is an 
oscillatory flow that arises in response to 
a steady temperature difference.

The thermally driven Josephson ef-
fect is partly a consequence of a quan-
tum-mechanical effect known as the 
fountain effect, in which a tempera-
ture difference in a superfluid is ac-
companied by a pressure difference. The 
thermally driven Josephson effect 
may have significance for the develop-
ment of a high-resolution gyroscope 
based on the Josephson effect in a su-
perfluid: If the pressure-driven Joseph-
son effect were used, then the fluid on 
the high-pressure side would become 
depleted, necessitating periodic inter-
ruption of operation to reverse the 
pressure difference. If the thermally 
-driven Josephson effect were used, 
there would be no net flow and so the 
oscillatory flow could be maintained 
indeﬁnitely by maintaining the re-
quired slightly different temperatures 
on both sides of the junction.

This work was done by Konstantin Penanen 
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Perturbation Effects on a Supercritical C7H16/N2 Mixing Layer

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A computational-simulation study has 
been presented of effects of perturba-
tion wavelengths and initial Reynolds 
numbers on the transition to turbulence 
of a heptane/nitrogen mixing layer at 
supercritical pressure. The governing 
equations for the simulations were the 
same as those of related prior studies re-
ported in NASA Tech Briefs. Two-dimen-
sional (2D) simulations were performed 
with initially imposed spanwise perturba-
tions whereas three-dimensional (3D) 
simulations had both streamwise and 
spanwise initial perturbations.

The 2D simulations were undertaken 
to ascertain whether perturbations hav-
ing the shortest unstable wavelength 
obtained from a linear stability analysis 
for inviscid flow are unstable in viscous 
nonlinear flows. The goal of the 3D 
simulations was to ascertain whether 
perturbing the mixing layer at differ-
tent wavelengths affects the transition 
to turbulence. It was found that transitions to turbu-
ence can be obtained at different per-
turbation wavelengths, provided that 
they are longer than the shortest unsta-
ble wavelength as determined by 2D lin-
ear stability analysis for the inviscid case 
and that the initial Reynolds number is 
proportionally increased as the wave-
length is decreased. The transitional 
states thus obtained display different dy-
namic and mixture characteristics, de-
parting strongly from the behaviors of 
perfect gases and ideal mixtures.

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