

```
> restart;
> with(Riemann):with(Canon):
> with(TensorPack) : CDF(0) : CDS(index) :
```

Chapter XX

Tensor analysis using indices - Senovilla et al. - Shearfree for acceleration perpendicular to vorticity

if $\sigma_{ab} = 0 \Rightarrow \omega_{\Theta} = 0$

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SSSeq29

In this file we show a proof of SSSeq29. We require the equations HC51 and HC52.

```
> read "EFE" : read "SFE" : read "fids" : read "Seneqs2d" :
```

i.e. using

```
> HC[51] := P[-a, b] * omega[c] * omega[-b, -C] = u[-a] * theta * 'p'' * omega^2 - 2/3
* omega^2 * u[-a] * theta + omega[-a, -n] * omega[n, m, -M] - omega^2 * du[-a]
+ du[-p] * omega[p] * omega[-a] + omega * omega[-A] : T(%);
```

$$P_a^b \omega^c \omega_{b;c} = u_a \theta p' \omega^2 - \frac{2}{3} \omega^2 u_a \theta + \omega_{an} \omega^{nm}{}_{;m} - \omega^2 du_a + du_p \omega^p \omega_a + \omega \omega_{;a} \quad (1.1)$$

```
> HC[52] := P[-a, b] * omega[c] * omega[-c, -B] = u[-a] * theta * 'p'' * omega^2 - 2/3
* omega^2 * u[-a] * theta + omega * omega[-A] : T(%);
```

$$P_a^b \omega^c \omega_{c;b} = u_a \theta p' \omega^2 - \frac{2}{3} \omega^2 u_a \theta + \omega \omega_{;a} \quad (1.2)$$

We can prove:

```
> HC[53]
```

```
:= parse("P[-a,b]*omega[c]*omega[-b,-C]-P[-a,b]*omega[c]*omega[-c,-B] = -omega^2*
du[-a]+du[-p]*omega[p]*omega[-a]+omega[-a,-n]*omega[n,m,-M]") : T(%);
```

$$P_a^b \omega^c \omega_{b;c} - P_a^b \omega^c \omega_{c;b} = -\omega^2 du_a + du_p \omega^p \omega_a + \omega_{an} \omega^{nm}{}_{;m} \quad (1.3)$$

This is an easy proof: the difference between the equations HC51 and HC52 is:

```
> temp := lhs(HC[51]) - lhs(HC[52]) = rhs(HC[51]) - rhs(HC[52]) : T(%);
```

$$P_a^b \omega^c \omega_{b;c} - P_a^b \omega^c \omega_{c;b} = -\omega^2 du_a + du_p \omega^p \omega_a + \omega_{an} \omega^{nm}{}_{;m} \quad (1.1.1)$$

```
> HC[53] := isolate(temp, omega[-a, -n] * omega[n, m, -M]) : T(%);
```

$$\omega_{an} \omega^{nm}{}_{;m} = \omega^2 du_a + P_a^b \omega^c \omega_{b;c} - P_a^b \omega^c \omega_{c;b} - du_p \omega^p \omega_a \quad (1.1.2)$$

```
> eq[29] := HC[53] :
```

this is a general proof of SSSeq29 (no dust assumption required).

> **save eq, "Seneqs2e" :**

> *convert(HC[53], string);*

"omega[-a,-n]*omega[n,m,-M] = omega^2*du[-a]+P[-a,b]*omega[c]*omega[-b,-C]-P[-a,**(1.2.1)**
b]*omega[c]*omega[-c,-B]-du[-p]*omega[p]*omega[-a]"

>