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

Chapter XX Tensor analysis using indices - Senovilla et al. - Shearfree for acceleration parallel to vorticity if $\sigma_{a\,b}$=0 =>ωΘ=0

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eq71

```
> read "EFE" : read "SFE" :read "fids" :read "Seneqs80" :
> SSSeq71 := Psi[-A]*omega[a] = (3·(`p'`/Psi)^2 + 1/3)·theta^2 - 2(1 + Psi^2)·omega^2
      + (mu + 3·p)/2 : T(%);
```

$$\Psi_{;a}\,\omega^{a} = \left(\frac{3\,p^{2}}{\Psi^{2}} + \frac{1}{3}\right)\theta^{2} - 2\left(\Psi^{2}+1\right)\omega^{2} + \frac{1}{2}\,\mu + \frac{3}{2}\,p \tag{1.1}$$

proof of eq71: We commence with SSSeq20 and SSSeq69:

```
> temp := eq[20] : T(%);
```

$$dottheta + \frac{1}{3}\,\theta^{2} - 2\,\omega^{2} + \frac{1}{2}\,\mu + \frac{3}{2}\,p - du^{a}{}_{;a} = 0 \tag{1.2}$$

```
> temp2 := eq[69] : T(%);
```

$$thetadot = \frac{3\,p^{2}\,\theta^{2}}{\Psi^{2}} \tag{1.3}$$

```
> temp3 := expand(TEDS(dottheta = thetadot, temp)) : T(%);
```

$$thetadot + \frac{1}{3}\,\theta^{2} - 2\,\omega^{2} + \frac{1}{2}\,\mu + \frac{3}{2}\,p - du^{a}{}_{;a} = 0 \tag{1.4}$$

Now, with the assumption:

```
> temp4 := cod(du[a] = Psi·omega[a], -a) : T(%);
```

$$du^{a}{}_{;a} = \Psi\,\omega^{a}{}_{;a} + \Psi_{;a}\,\omega^{a} \tag{1.5}$$

and from SSSeq27

```
> temp5 := TEDS(du[a]·omega[-a] = Psi·ω^2, TEDS(omega[a,-A] = 2·du[a]·omega[-a],
      temp4)) : T(%);
```

$$du^{a}{}_{;a} = 2\,\Psi^{2}\,\omega^{2} + \Psi_{;a}\,\omega^{a} \tag{1.6}$$

and so

```
> temp6 := TEDS(temp5, temp3) : T(%);
```

$$thetadot + \frac{1}{3}\,\theta^{2} - 2\,\omega^{2} + \frac{1}{2}\,\mu + \frac{3}{2}\,p - 2\,\Psi^{2}\,\omega^{2} - \Psi_{;a}\,\omega^{a} = 0 \tag{1.7}$$

```
> temp7 := collect(TEDS(temp2, isolate(temp6, Psi[-A]·omega[a])), [θ^2, ω^2]) : T(%);
```

(1.8)

$$\Psi_{;a}\,\omega^{a} = -\frac{1}{6}\,\frac{\left(-2\,\Psi^2 - 18\,p^2\right)\theta^2}{\Psi^2} - \frac{1}{6}\,\frac{\left(12\,\Psi^4 + 12\,\Psi^2\right)\omega^2}{\Psi^2} - \frac{1}{6}\,\frac{-3\,\Psi^2\,\mu - 9\,\Psi^2\,p}{\Psi^2} \tag{1.8}$$

```
> convert(temp7, string);
```

```
"Psi[-A]*omega[a] = -1/6*(-2*Psi^2-18*`p'^2)/Psi^2*theta^2-1/6*(12*Psi^4+12*Psi^2)
    /Psi^2*omega^2-1/6*(-3*Psi^2*mu-9*Psi^2*p)/Psi^2"
```
(1.9)

which is SSSeq71

```
> SSSeq71 := Psi[-A]*omega[a] = (3·(`p'/Psi)^2 + 1/3)·theta^2 - 2(1 + Psi^2)·omega^2
      + (mu + 3·p)/2 : T(%);
```

$$\Psi_{;a}\,\omega^{a} = \left(\frac{3\,p^2}{\Psi^2} + \frac{1}{3}\right)\theta^2 - 2\left(\Psi^2 + 1\right)\omega^2 + \frac{1}{2}\,\mu + \frac{3}{2}\,p \tag{1.10}$$

check

```
> expand(rhs(temp7) - rhs(SSSeq71));
```

$$0 \tag{1.11}$$

```
>
>
>
```