Cyprometry (Applications of Applications of Ap		1 nal 18
* no clas	s on thu! Long H	n Ineceyo
SO FAR:	EQUÍV. LIF PRINCIPLE free fo	II /associate
		Rieman GEODESIC TENSOR
	Type digwedigiated war werken't er neuer of an an elementarium was an ellist had the ellisted of the ellisted	
	symmetries of	
	; developing pieces	
BIGGER PIC		
BIGGER PIC	1. Schwarzsc	
BIGGER PIC		

LAST TIME :

RIEMANN TENSOR

index of V on uts

[Dr. Dr]VP - RP onv VE

(TORSION-FREE)

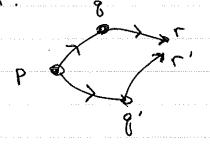
contracts Von RHS

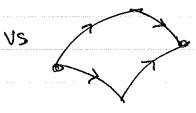
ANTOSYM indices

Ronv = Ortre + Thy Tro - (Menu)/

PEMOVES HON-TENSORIAL
PART, OF ENSURING
WELL BEHAVED
TRANSFORMATION

BUT WE WERE CONFUSED: are we actually comparing vectors @ the same spacetime point?





106A: LHS is A SMALL CORRECTION TO RHS
C full deviation

L.D. tem

Zee IX.1	LET'S TAKE A SUGHTLY DIFF. APPROACH.
	SCC) I "SMAIL"
+ PBIT:  + PBIT:  perbliel  House  along V(C),  Whether or  not Vis  a geodesic	Some closed curve, T(T)  Start WI vector @ P  then push it around the loop  i ask how it has changed when  it returns to p.
	IV' = V'(T1) - V'(T0)  EIRET: to avoid dutter, it is useful to  ask the same guestion with  the one-form Vo = gop V'
	Completely Equivalent inpo, except indices will be s.t. we identify $R^e_{\sigma FV}$ ? The end.

ASOE 1

RECALL: COVARIANT DERIVATIVE TELLS US

WHAT HAPPENS TO A VECTOR AS

I PUSH IT IN A CURVED SPACE

3/3×x Nb(x) D× Nb = 3× Nb + Lxo No

SO ALONG A WEVE Y(T),

DVP = 8>9, VP + 8> LAGVE

 $% = \frac{48}{45}$ , velocity vector  $% = \frac{48}{45}$ 

THE VECTOR V ALONG V(T) IS GIVEN
BY SOWING THE 1ST Q ODE

1 95 + Lb 8 x Ne = P

Mb: Y(I) needo! the a goodesic! (WE'RE STILL PARAMEL TRANSPORTING)

annigh framail Birthelia an tao ann an t-airm an t	WE ARGUED THAT FOR LOWER INDICES.
	Dy Vo = 2, Vo - Tyo Vo  [ Impices "HAD TO BE" UKE THIS  MIMUS!  come from 2x/2x' from from  matrix us 2x'/2x.
ASIDE 2	ALTERNATIVE DERIVATION:
	V"Wr = V.W 18 a scalar
	["WIWL 008 A"
المادة المساوحة المادة الم	when we parallel transport, relative
	angle unchanged
	3E (V-W) = [-(Fpo Vo) Wn - Vr (Fpo W)] 36
	$\begin{array}{c} 1 \\ 0 \\ \end{array} \rightarrow \begin{array}{c} 1 \\ \Gamma \gamma \rho = \Gamma \gamma \rho \end{array}$
N 1880 (1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887 - 1887	(REUBEL DUMMY INDICES)
	- Lbe NoM - Ltb N+M = 0
erigini, geligini, g Tanan kanan ka	FREVEWA.
	S.t. Fpo = - Tpo

4810E 3	SIDE-SIDE NOTE
	WHEN WE PARAMEL TRANSPORT A VECTOR, WE EXTEND IT ALONG Y(T)
	then £ (V·W) = 0
	Y(T) rector fields
	CONTRAST TH'S TO $\Phi(x) = V(x) \cdot W(x)$
	Drtw = grdx)
	是中一多多中国
and the second s	

So: 
$$\Delta V_{\sigma} = V_{\sigma}(z_{1}) - V_{\sigma}(z_{0})$$

$$= \int_{z_{1}}^{z_{2}} dz \int_{dz_{0}}^{dz_{0}} dz$$

$$= + \int_{x_{0}}^{x_{0}} \sqrt{y} \sqrt{y}$$

$$\int_{z_{1}}^{z_{2}} dz \int_{z_{2}}^{z_{2}} dz \int_{z_{2}}^{z_{2}} dz$$

$$= \int_{z_{1}}^{z_{2}} dz \int_{z_{2}}^{z_{2}} dz \int_{z_{2}}^{z_{2}} dz$$

$$= \int_{z_{2}}^{z_{2}} dz \int_{z_{2}}^{z_{2}} dz$$

SVo >0 AS [] ->.
mo transport

but how? what does it scale with?
PERIMETER OR AREA?

not this: The sale = 0

so DVo ~ area endosed

A SA	
CONTROL TOPOGRAPHICA	80: HOW DO WE DESCRIBE AREAS?
NAME OF TAXABLE PARTY OF TAXABLE PARTY.	Y CROSS PRODUCTS YXW
ognovanananan	Z/->W
Market Market Constitution Con	antisymmetric machine that takes
- Contractor Contractor	2 vectors & spits out oriented
020-1-0-1-0-1-0-1-0-1-0-1-0-1-0-1-0-1-0-	area
- Constitution of the Cons	
	HIGH-FAUTIN' LANGUAGE: 2-FORM
TOTAL STREET,	dx + v dx = = = (dx + about 8 dx - dx 8 dx h)
*	
Company of the Compan	K-form: antisymmetric map from
S. Andrew W. Common Processing	$V^{k} \rightarrow R$
	Eventor space, like TPM
CONTRACTOR OF THE PERSON OF TH	
	IT SUFFICES FOR US THAT THE AREA IS
***************************************	GIVEN BY A TENSOR ATV = -AVM
	(really Sx" x Sx")
	So: DVo & At AMD & Vo itself
-	AVo = Roper Vp Arr = \$ dx > the
-	
-	nature, next to about that this

is the Riemann

WRITE: \$ dx > Trolo = \$ dx (TV)

just doop indices

for simplicity

then we can taylor expand integrand about  $X_0 = X(T_0)$ 

 $(tV) = (tV)_o + \partial_x(tV)_o (x-x_o)_o^x + \cdots$   $vonishes \qquad vanishes m &$ 

this term: 3x(LN) rol 8 9xxx

eg. Green's thin/ Stokes' thin (UNICS OF AREA)

Np: by integration by parts

Np: by integration by parts

No poundary

80: and linear term is importent leading prece. (athers vanish as area shrinks)

NEED TO SHOW: this is the same premun TENSOR AS BEFORE

EXPAND TO LINEAR ORDER

Γρο = Γρο (x0) + 2, Γρο (x-x0) + ...

 $V_{\rho} = V_{\rho}(x_{o}) + \frac{dV_{\rho}}{d\tau} (\tau_{i} - \tau_{o})$   $+ \tau_{\lambda \rho} \dot{\delta}^{\lambda} V_{\beta} (\tau_{i} - \tau_{o})$ 

3xx (z-zo) = (x-xo)x

= Vp(xo) + TBP VB(x-xo)

⇒ LVo = 2d[tcoVo]/xo Axx

= (TOB) TOP VB + DatioVP) xo Ald

or ut. now need to change indices

DVo=Rom Vp AW

ŀ	
Madella and address of the last	1st term x, x, B -> t, v, P
and the same of the same	trothe motive
ernandahanna peralamak	C DV & stays
Athenative with a feature	2nd tru : > d → hV.
لامدتك سمت كمدشاها وموكسا ومو	c tem . v.a
THE REAL PROPERTY OF THE PERSONS	Date : + + Dutro
American Artifician American	
لامستسلامهساليوناهم	
Charles William Charles	=> DV= = ( Dutho + Thotas) Ve AFV
-	1
-	
- and the street of the street	Musymmetric
A TOTAL OF THE PARTY OF THE PAR	
Commence of the Control of the Control	so you get (-)(re-v)
DEPARTMENT OF THE PROPERTY OF THE PARTMENT OF	maybe factor of 1/2
	maybe overall sign
-	may was significant
- Contraction of the last of t	BUT PHYSICAL CONTENT IS CUEAR, YES?
- AND	
- Charles be annual representation	SVo = ROTU VAAW
·	
**************************************	
Name of Persons of Street, or other Persons of Street, or	different deriv. of Ri
1	

and the second s

carroll 3.8	Something different
	GEODESIC FO: VELOCITY VECTOR & ALONG GEODESIC (free foll) is PARAMER TRANSPORTED
	A SXP
	1 (V·D).Vr = 0
	DRECTIONAL COVACIANT DECLUATIVE
	ge 3c y
	PHYSICS: 4-wowentrum; b= m/
	(massless: 7 no good, use P dx dx)
	8.4. GEODESIC: (D.D) PL =0
	bw: (p.4) P =0 ⇒ \$= 5000 cm bg. =0
	then: (p.D)Pr=(p.8)Pr-Tonpop.

CONNECTION TERM

along geodesic

antisym in >=>V

(SAM OF WARD)

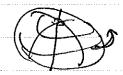
150M: M->M s.t. grv UNCHMEED

Noether's thin in oursed space

WANT TO MAKE THIS MORE TRANSPARENT (IN ugly osores, not devious that governor)

also: can have more
180 metries than coordinates
eg Rot, Borost, TRANSL. in Minkowski

in the direction of an isometry



"K generates isometey"

CONSTRUED ANANTITY: WINDSTEAL K-P

= Prp Drkv = Prkv (Drkv) pv + prkv (Drpv)

D(rKv) (sym. part)

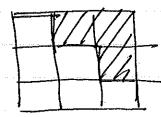
	KIMNGS EQ: D(+K1) = 0 => P.D(K.P) =0
and the state of t	1
garage	if K satisfies this
	(sym part of Cov. DEE)
amanya asami ana ana ana ana 1900 at 1	
, ng nga pagganasa perupagan pagan pagan paggan	then K.P is conserved
a for addy ship self. I for the self of th	along worldline.
	say: Kr is a Killing vector Field
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go ang	film about Knower Rauge
	3 ongoing TV series about
t sammer han steady of company and sell park (Physiquesh samille 1 m24 mass 40 at 1 decision) 2004, 100 at 100	murder of a dead express of
	its existence -> conserved quantity.
	The state of the s
ing and comparing the contract of the contract	since 3m is unchanging in K dr.,
ر در در از در	s.t momentum in that div. is cons.
tta viintava senastava tee aasaa saameen sa kanta kanta kanta kanta ka	
Newb. 6.5 711.1	IN: DrDoKP=RPorvKV
Andrew Control of the	NO SYSTEMATIC WAY TO WRITE ALL KILLING FIECDS.
r også (freman frekligt), mådad (hall) om att det det 1925 frem frem om och ett orden til 1974 och det ett det 1975 i 1882 200	
<b>V</b>	given K 1 DK, have 2nd ? higher doivatives
, agggat aggreen of new mass or new constitution in the site of th	reason to lower herenatives
•	

## K+(x) = f(x), K, (x0) + d(x), & D. K, (x0)

in 2-2m. 4 DOF

2d(d-1)

since D+Kv +DvKH =0



sym pièce unitales left w/ antisym bart of DK

80: UP TO d+ \(\frac{1}{2}d(d=1)\) = \(\frac{1}{2}d(d+1)\) 1944 VECTORS

A SPACE W/ FUL SET OF KLUING VECTORS MAXIMAUM SYMMETRIC

: 4 translations (HomoGenerals) MINICOUSE & "ROTATIONS" (180TROPIE)

= 10 Killing

= 4(4+1) = 10 /

Betau	SALERICALLY SYMMETRIC SPACES
Cheng 7-1	
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	985 = 9F5 - 9L5 - L5 (905 +8120 9165)
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n van meter til stade en en mener det medligt meter sid et til film film för å det sid et de forste for å de s	HOW TO GENERAY'ZE WHILE MAINTAINING SAHR, SYM?
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t and algorithm to the state of	( x i i dxi must appear in dat products
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	$48_5 = 4 q \times_3 + B(\overline{x}, q \times)_5 + Cqf(\overline{x}, q \times) + Dqf_5$
is the subsequent angular to a second subsequent and the second subsequent and second	Princtions of Elx2.
n, de novembre de la companya de la	PINCHALS OF E L
ini, uma antika untuk kalandaran kalandaran kalandaran kalandaran da antika da mateka kalandaran da	= A[dr2 + r2 ds2] + Br2dr2 + Crdrdt + Ddt
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	B = A+Br2 s.t. Bdr2
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ANTIQUE DE LA PROPERTIE DE LA	
The second second second second second	d82 = Crdrdt + Ddt2 pEABSORB
CALIFORNIA (CONTRACTOR)	1 + D7E3-D(E,)3425
· seemand company comments	
Consumption of the Consumption	-2Df'dr dt
\$1.00 miles	choose: Cr = 2Df
S S S S S S S S S S S S S S S S S S S	V
7.	ds2 = A-2d22 + Bdr2 + DdE2
	1 - D(t, 1) = 4
~-	
	s B L 2
-	$\tilde{r}^2 = Ar^2 \rightarrow \tilde{R} d\tilde{r}^2$
****	
•••	

}	
	DROPPING ALL ORNAMENTATION (31) Miding arbitrary functions, anyway !)
	d82=900 dt2 + grade2 + r2 ds23
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