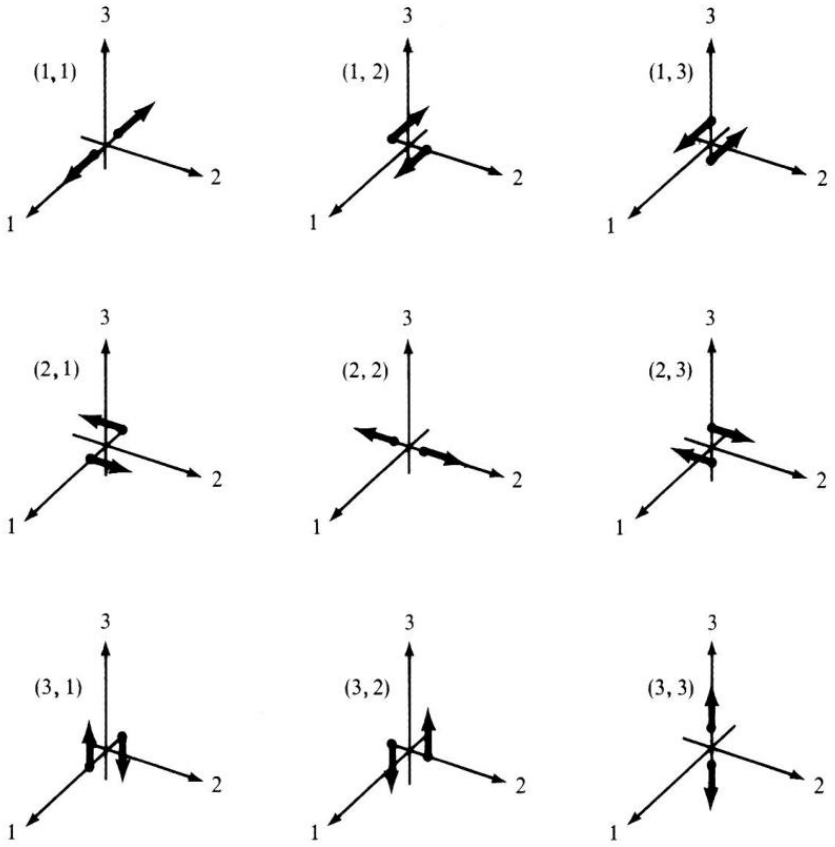
Moment Tensor 101

Underpressure Class

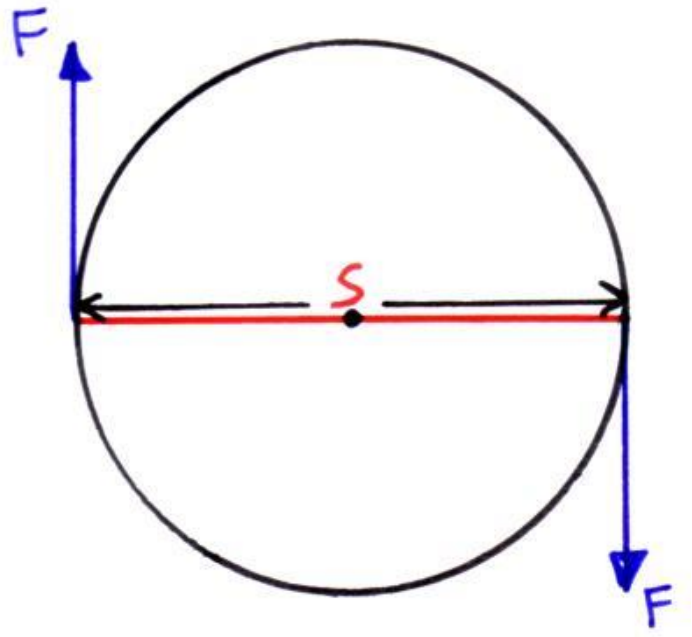
Intro



$$s_n(\boldsymbol{x}, t) = M_{pq} * G_{np,q}$$

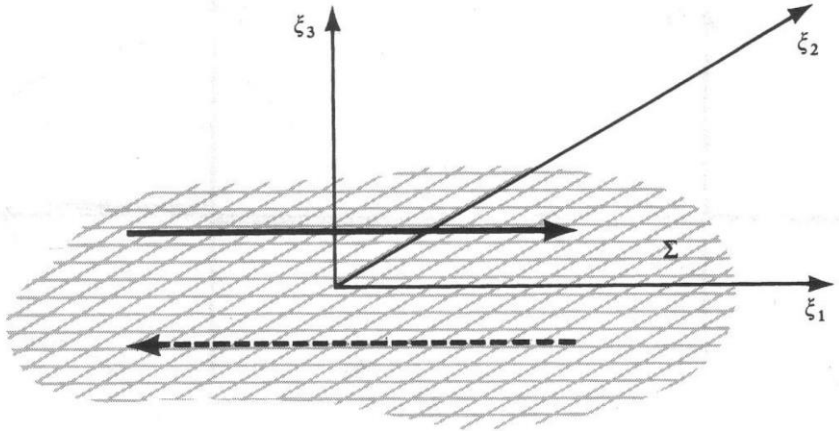
Underpressure Class

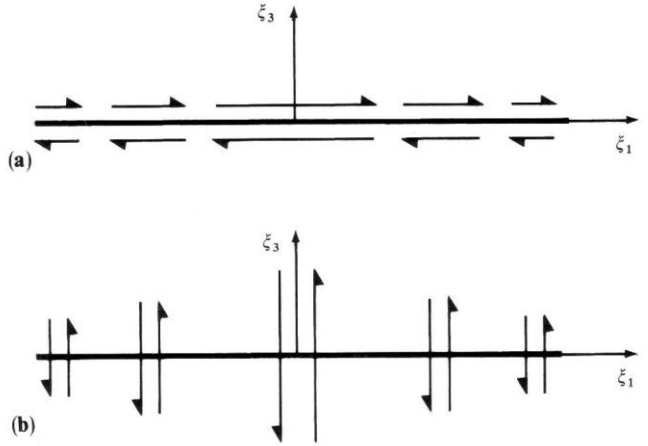
What is a couple



- In mechanics, a **couple** is a system of forces with a resultant (a.k.a.net or sum) moment but no resultant force

Moment Tensor





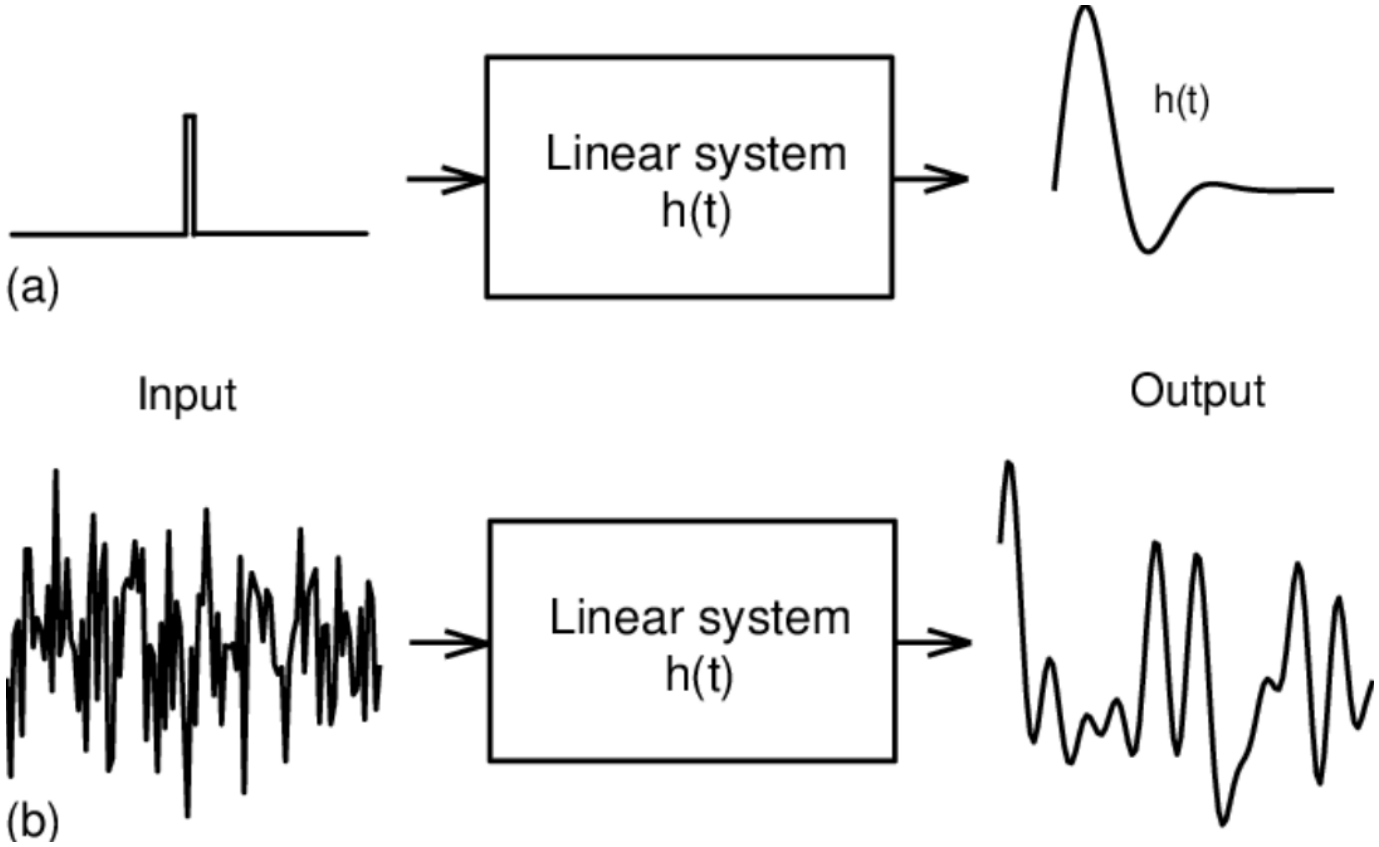
Since faulting within the volume V is an internal process, the total momentum and total angular momentum must be conserved. It follows that the total force due to $\mathbf{f}^{[\mathbf{u}]}$, and the total moment of $\mathbf{f}^{[\mathbf{u}]}$ about any fixed point, must be zero. Thus

LTI (Linear Time-Invariant) system

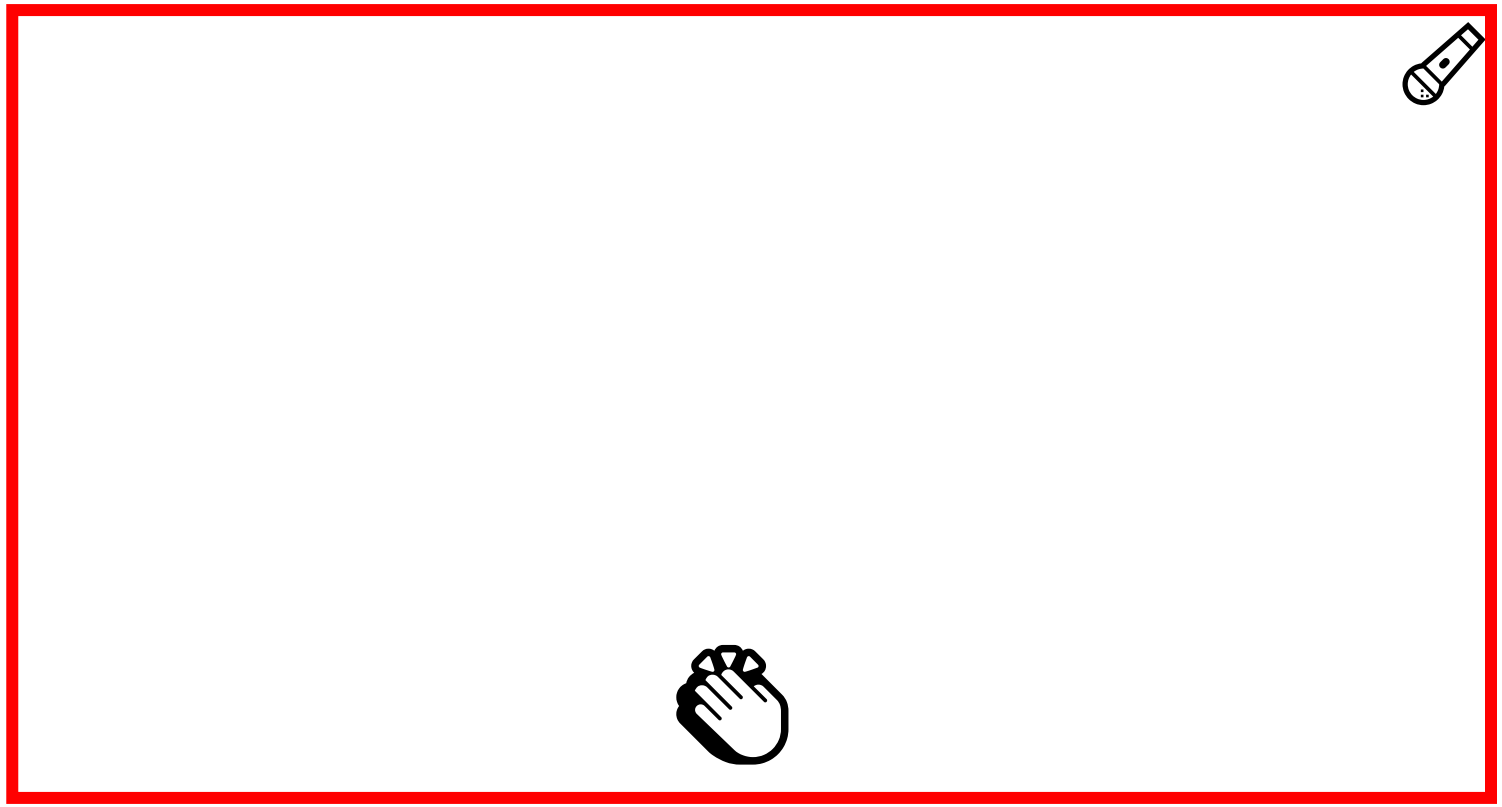
Response function

B	**Time domain:**	$u(t)$	$h(t)$	$y(t)$
C	Linearity:	$u_1(t)$		$y_1(t)$
		$u_2(t)$		$y_2(t)$
		$au_1(t)+bu_2(t)$		$ay_1(t)+by_2(t)$
D	Time invariance:	$u(t-T)$		$y(t-T)$
E	Input–output relation:		$\int u(\tau)h(t-\tau)-d\tau = y(t)$	
F	**Frequency domain:**	$U(\omega)$	$H(\omega)$	$Y(\omega)$
G	Input–output relation:		$U(\omega)\times H(\omega) = Y(\omega)$	

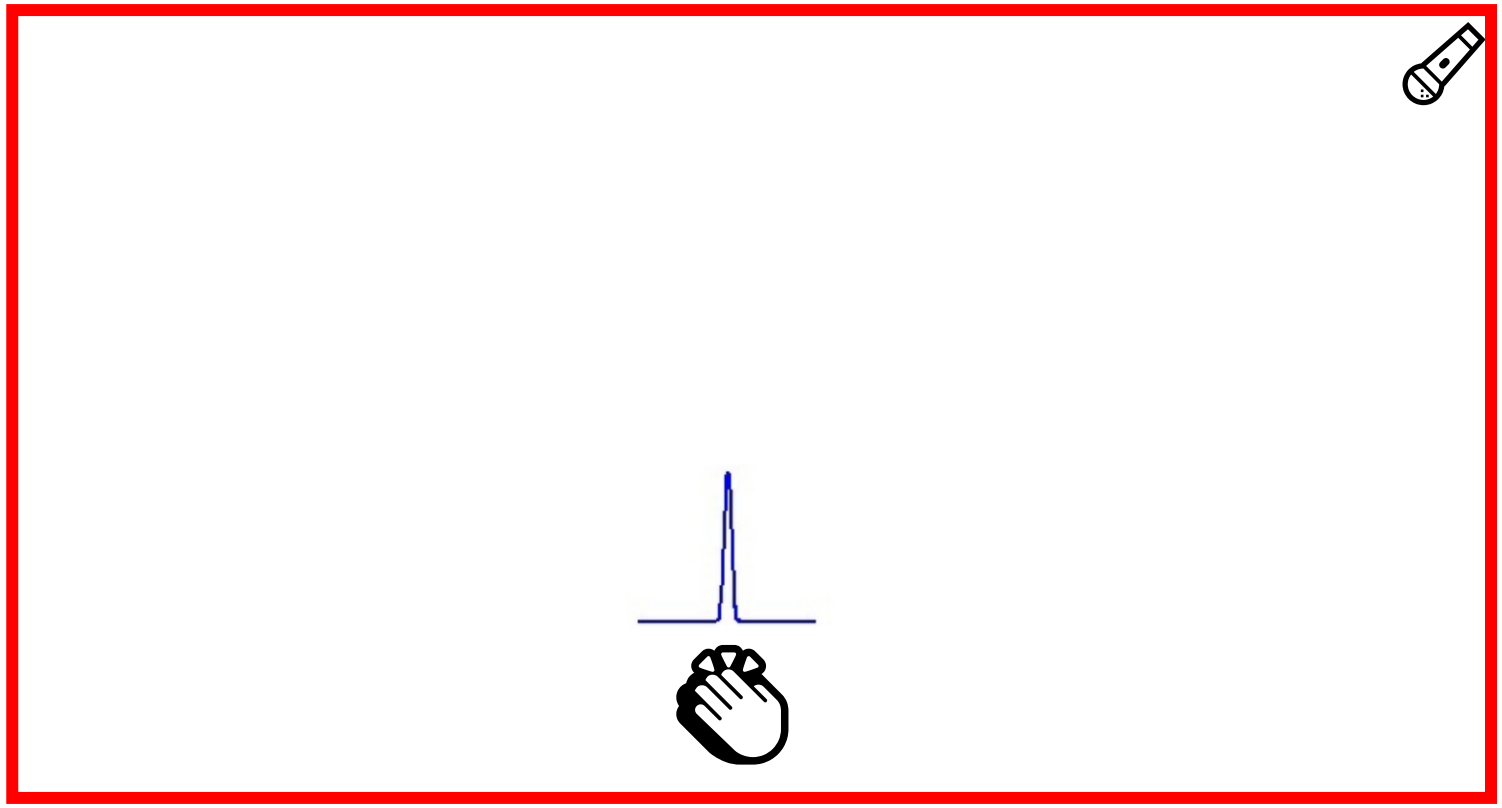
LTI (Linear Time-Invariant) system

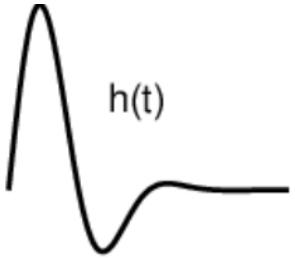


LTI system & Green’s function



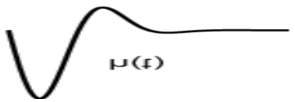
LTI system & Green's function

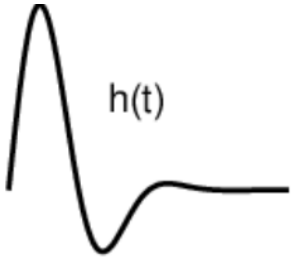




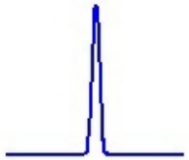
Impulse response / Green's function of the room

LTI system & Green's function

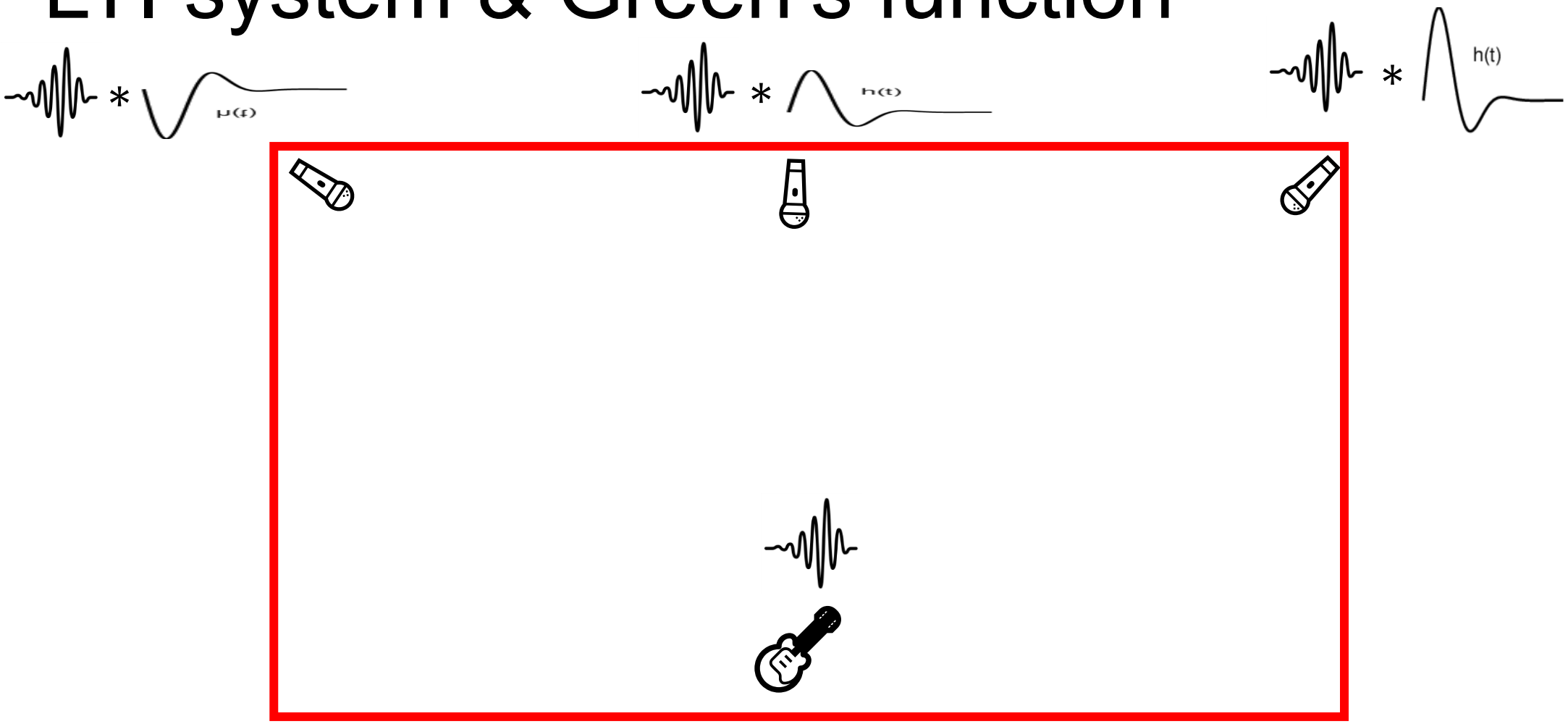




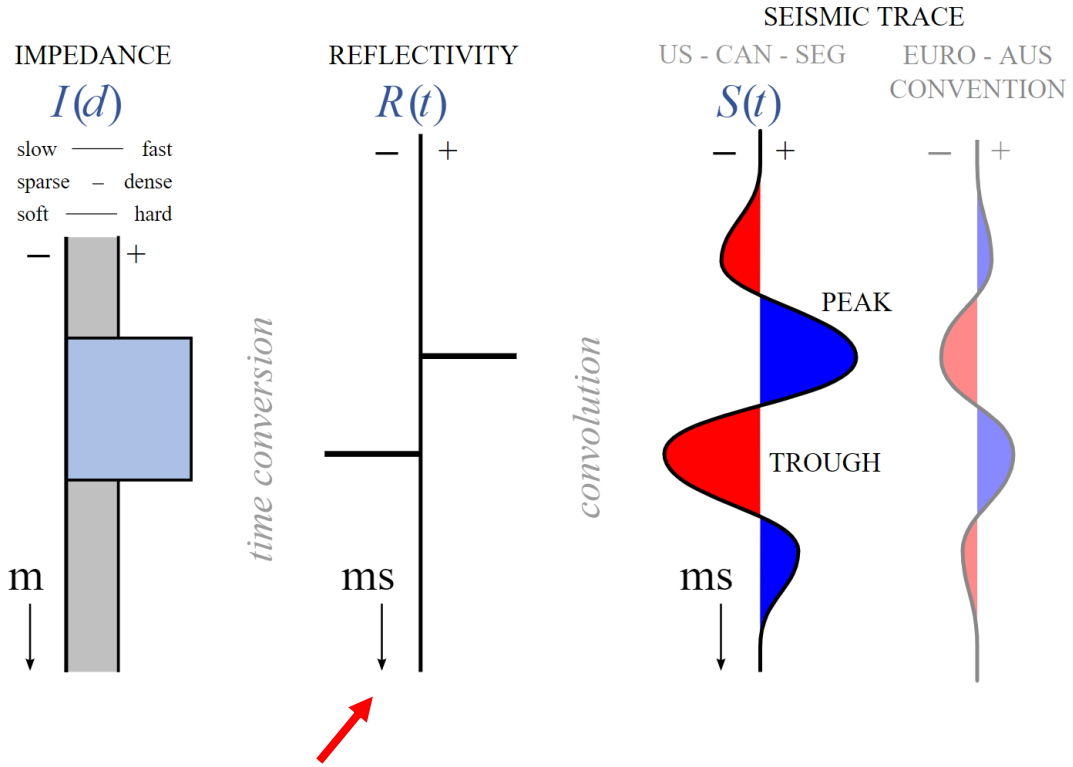
Impulse response depends on **the location of source-receiver pair** and **the medium between** those source-receiver pair



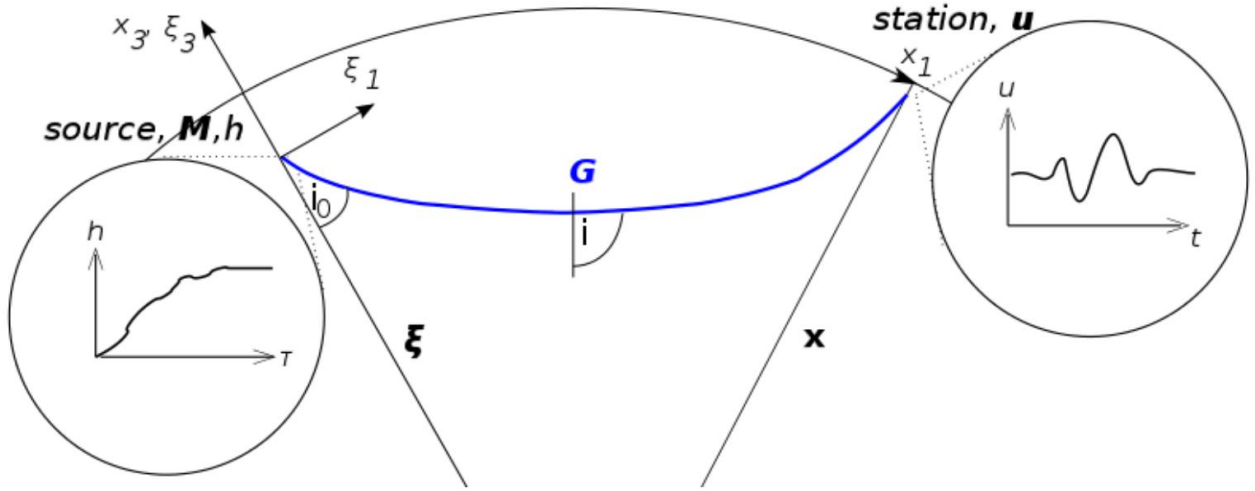
LTI system & Green's function



Green's function



Reflectivity =
Impulse response /
Green's function!



Green's function

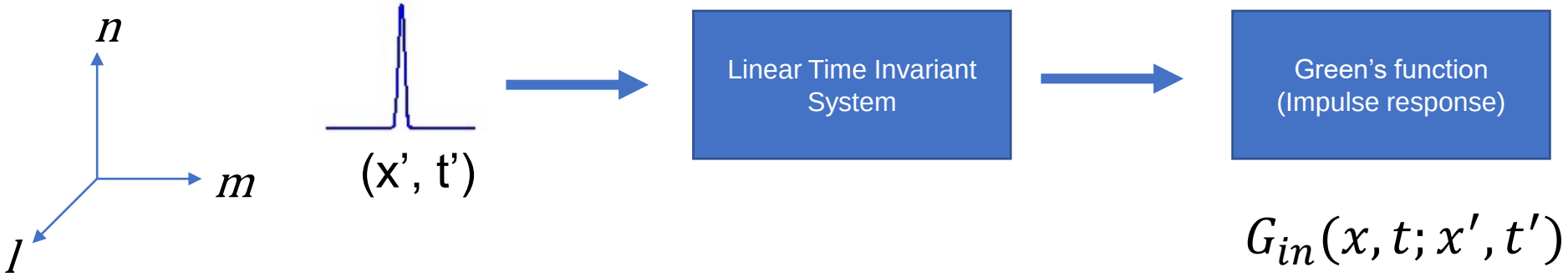
$$\rho \frac{\partial^2 u_i}{\partial t^2} - c_{ijkl} \frac{\partial u_k}{\partial x_l} = f_i$$

$$\underbrace{\qquad\qquad}_{L(u)}$$

$$L(u) = f$$

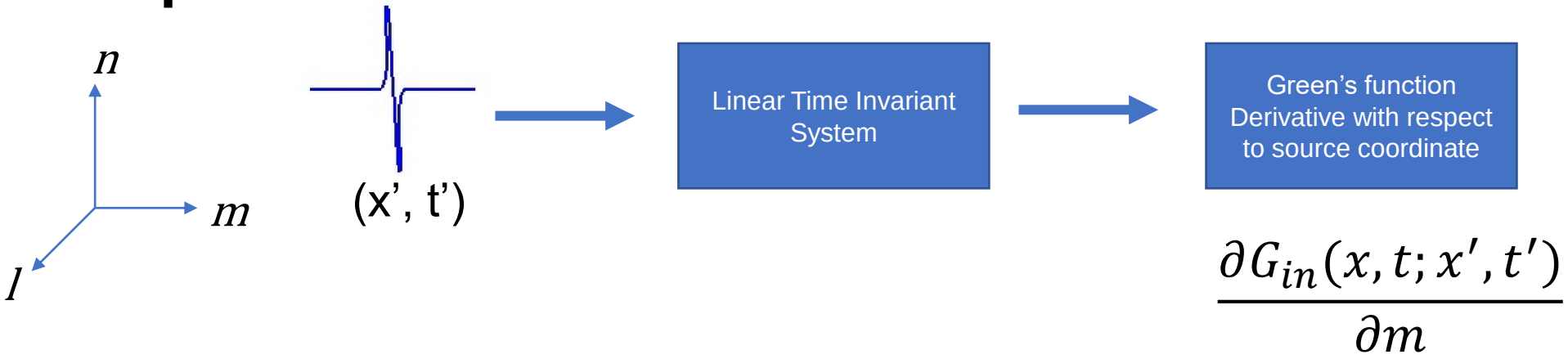
$$L(G) = \delta$$

Green's function due to unit impulse



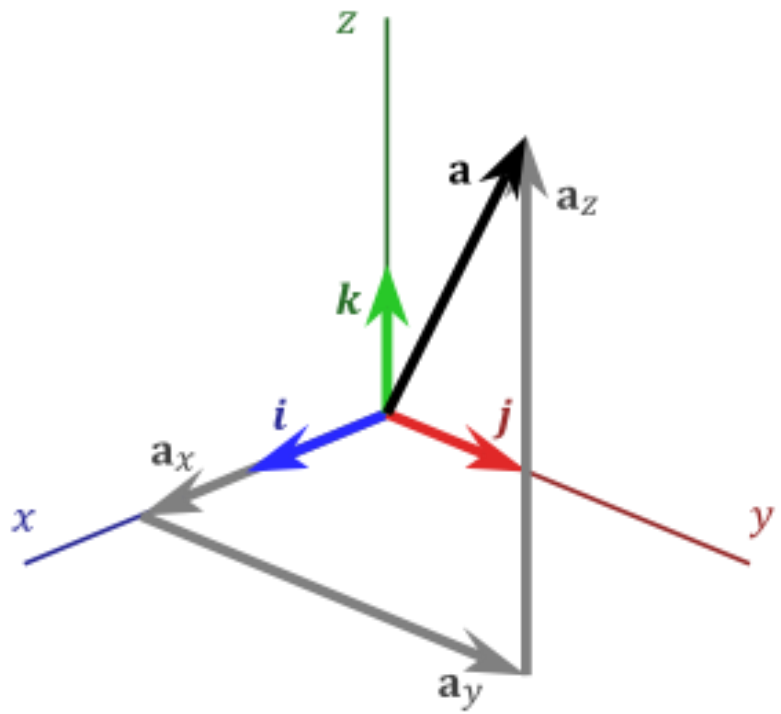
i-th component of displacement at location x and time t, due to a unit impulse in the **n** direction at location x' and time t'

Green's function due to unit impulse couple



Response of a single **couple** with a force in the **n** direction and arm in the **m** direction

Vector refresher



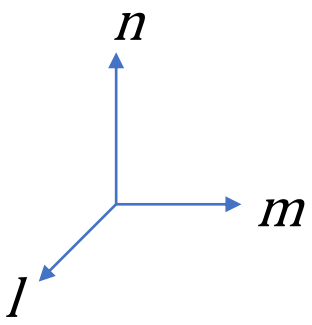
- We can go anywhere in 3d space using linear combination of 3 orthogonal **basis vectors (i, j, k)**

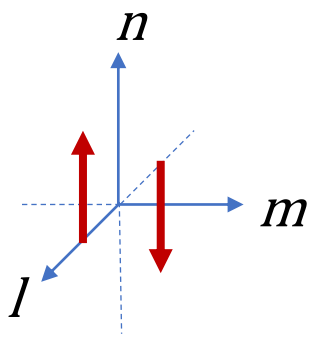
$$\boldsymbol{v = a\hat{\imath} + b\hat{\jmath} + c\hat{k}}$$

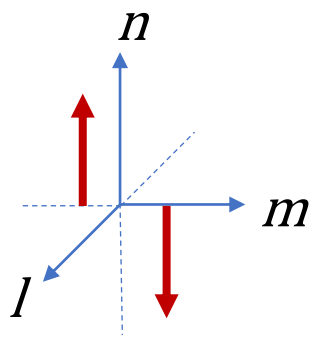
- In other words, linear combination of three orthogonal basis vectors (v) **“spans”** the whole 3d space

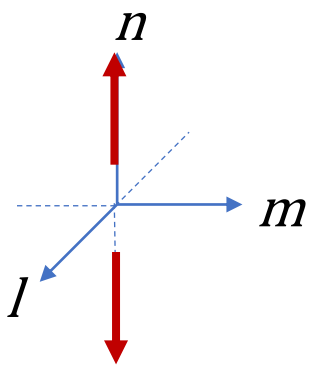
Moment Tensor

$$s_i(x,t) = M_{nl}\frac{\partial G_{in}(x,t;x',t')}{\partial l} + M_{nm}\frac{\partial G_{in}(x,t;x',t')}{\partial m} + M_{nn}\frac{\partial G_{in}(x,t;x',t')}{\partial n}$$

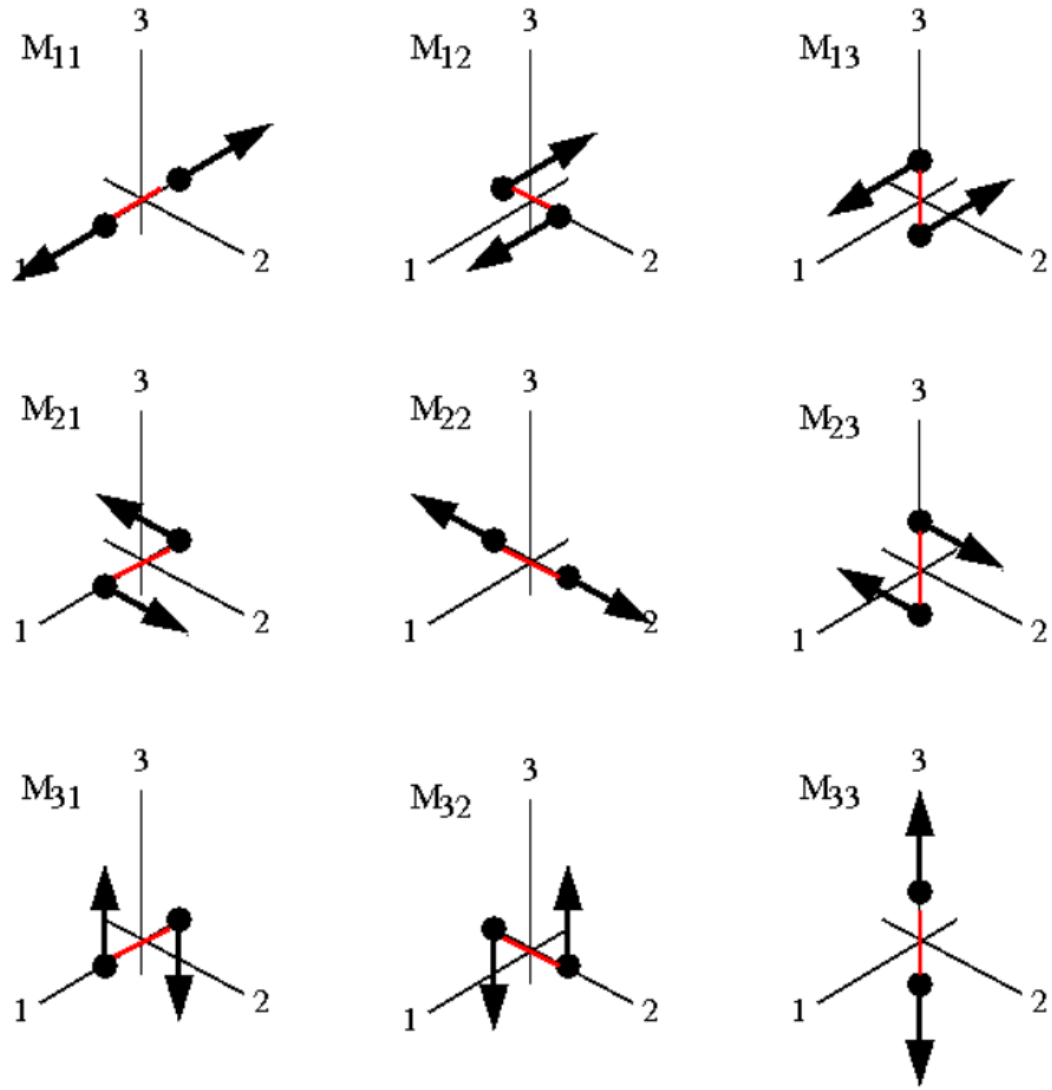








Untuk orientasi bidang sesar acak:
Kombinasi 3 arah gaya dan 3 arah lengan gaya -> 9 komponen momen tensor


M11
3
1
2
M12
3
1
2
M13
3
1
2
M21
3
1
2
M22
3
1
2
M23
3
1
2
M31
3
1
2
M32
3
1
2
M33
3
1
2