1.1. Mecanica lui Newton

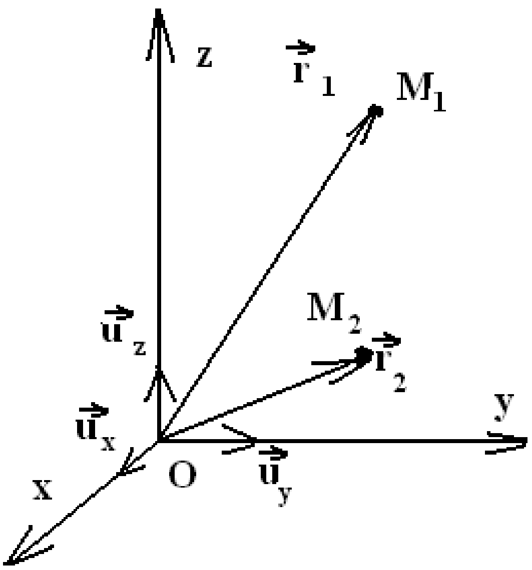
1.1.1. Cinematica

Studiem **puncte materiale** care au mase si care se misca fata de un **sistem de referinta**. Pozitiile lor sunt descrise de **vectori de pozitie** in 3D.

Ce e masa ?

De ce vectori ?

Definitii si notatii



Viteza instantanee a unui punct estevariatia pozitiei sale in timp

$$\vec{v}(t) = \frac{\mathrm{d}\vec{r}}{\mathrm{d}t} \equiv \dot{\vec{r}} \qquad (1.1.1)$$

Acceleratia este variatia in timp a vitezei:

$$\vec{a}(t) = \frac{\mathrm{d}\vec{v}}{\mathrm{d}t} = \frac{d^2\vec{r}}{dt^2} = \ddot{\vec{r}} \qquad (1.1.2)$$

Exemplu important: **Coordonatele polare**

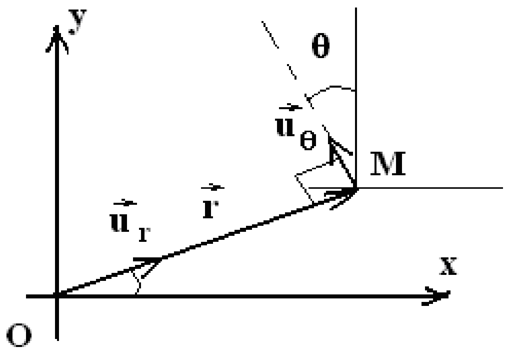


Fig. 1.1

VERSORI

$$\vec{r} = r\vec{u}_r = x\vec{u}_x + y\vec{u}_y \qquad x = r\cos\theta, \quad y = r\sin\theta \tag{1.1.3}$$

$$\vec{u}_r = \cos\theta\,\vec{u}_x + \sin\theta\,\vec{u}_y \qquad \vec{u}_\theta = -\sin\theta\,\vec{u}_x + \cos\theta\,\vec{u}_y \tag{1.1.4}$$

Sau matricial:

$$\begin{pmatrix}\vec{u}_r\\ \vec{u}_\theta\end{pmatrix} = \begin{pmatrix}\cos\theta & \sin\theta\\ -\sin\theta & \cos\theta\end{pmatrix}\begin{pmatrix}\vec{u}_x\\ \vec{u}_y\end{pmatrix} \tag{1.1.5}$$

Daca unghiul θ variaza cu timpul, $\theta = \theta(t)$, variaza si versorii $\vec{u}_r$ si $\vec{u}_\theta$.

Viteza si acceleratia in coordonate polare sunt date de

$$\vec{v} = \dot{\vec{r}} = \dot{r}\vec{u}_r + r\dot{\vec{u}}_r = \dot{r}\vec{u}_r + r\dot{\theta}\,\vec{u}_\theta = v_r\vec{u}_r + v_\theta\vec{u}_\theta \tag{1.1.6}$$

$$\vec{a} = \ddot{\vec{r}} = (\ddot{r} - r\dot{\theta}^2)\vec{u}_r + \left(r\ddot{\theta} + 2\dot{r}\dot{\theta}\right)\vec{u}_\theta = (\ddot{r} - r\dot{\theta}^2)\vec{u}_r + \frac{1}{r}\left[\frac{\mathrm{d}}{\mathrm{d}t}\left(r^2\dot{\theta}\right)\right]\vec{u}_\theta \tag{1.1.7}$$

In particular, pentru miscarea circulara uniforma r=const, $\dot{\theta} = \omega$=const. Gasim

$$\vec{v} = r\omega\vec{u}_\theta \qquad \vec{a} = -r\omega^2\vec{u}_r \tag{1.1.8}$$