Technion-Israel Institute of Technology
**Faculty of Mechanical Engineering**

הטכניון-מכון טכנולוגי לישראל
**הפקולטה להנדסת מכונות**

# סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות, שתתקיים ביום ה׳ 4.01.2018 (י״ז בטבת, תשע״ח), בניין דן-קאהן, אודיטוריום 1 , 13:30.

**מרצה**: נטע בלום

**מנחה**: פרופ׳ דוד דורבן, הפקולטה להנדסת אוירונאוטיקה וחלל

**מנחה שותף**: ד״ר ברוך קרפ, הפקולטה להנדסת אוירונאוטיקה וחלל

**על הנושא:**

## Assessment of Saint-Venant Principle in Soft Biological Tissues

The seminar will be given in Hebrew

**להלן תקציר ההרצאה:**

Saint-Venant principle is commonly accepted as a central and useful idea in structural mechanics, particularly in engineering practice. However, while considerable research on the validity of this principle is available for standard structural materials, like metals, relatively few studies have examined the validity of the principle in biological tissues. This lacuna is surprising since there are numerous practical situations, like local defects in blood vessels, onset of aneurysm, stents insertion, skin injuries and membrane perforation that impose local self-equilibrating loads on bio-tissues. It is important to understand how stress and strain fields induced by such localized irregularities decay with distance from perturbed zone. Another practical context is the analysis of end effects, in experiments with bio-tissues, induced by the applied loads and boundary fixations. It is noted that unlike common metals, biological tissues admit large strains, are not isotropic and material response varies with age.

The present research aims at an initial theoretical analysis of diffusion with distance of self-equilibrating loads applied to biological tissues. Formulation is within the framework of finite strain, incompressible, continuum mechanics, employing laboratory verified hyperelastic constitutive relations. Results are presented over a range of tissues, including arteries, brain and liver.

We start with the simple cases of pressurized spherical and cylindrical cavities (simulating solid tumors) and examine intensity of near wall boundary layer build up, as deformation progresses. Decay rates are sensitive to levels of stretch and strong gradients develop within the Saint Venant zone (with possible influence on cell migration).

The second part of the lecture addresses decay of incremental end loads in an axially pre-stretched strip, in the style of Papkovich-Fadle classical linear elastic analysis predicting exponential decay. Again, considerable sensitivity of decay rates is exposed, as influenced by material properties and initial strain. A noteworthy result is that presence of transverse stretch lowers the axial decay rate, probably due to convexity of the strain energy function in bio tissues .

While this research is only an initial step in assessing the validity of Saint Venant principle in soft bio-tissues, it provides new and challenging observations that call for further study on the applicability of that fundamental principle in biomechanics.

בברכה,

*פרופ״א מתי סאס*
מרכז הסמינרים