



## פרופסור פאבל בלוב

דיקאן, הפקולטה לפיזיקה והנדסה,  
ראש המחלקה לננופוטוניקה ומטא-חומרים,  
האוניברסיטה לטכנולוגיות מידע, מכניקה ואופטיקה, סנט פטרסבורג, רוסיה

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סמינר | Seminar

## ENHANCEMENT OF MAGNETIC RESONANCE IMAGING WITH METASURFACES: FROM CONCEPT TO HUMAN TRIALS

### Abstract

Metasurfaces represent a new paradigm in artificial subwavelength structures due to their potential to overcome many challenges typically associated with metamaterials. However, despite the fact that many intriguing functionalities of metasurfaces have been demonstrated as "a proof of the principle", real practical applications of metasurfaces are still missing. One of the potential applications of metasurfaces is magnetic resonance imaging (MRI), where by means of the spatial redistribution of the near field it is possible to strongly increase the scanner sensitivity, signal-to-noise ratio, and image resolution. Here, we stress the importance of metasurfaces for improvement of MRI characteristics and present in vivo results obtained with different types of metasurfaces at high (1.5T) and ultra-high (7T) field MR machines. We propose and discuss methods of tuning eigenmode resonance frequencies of wire metasurfaces. Fine tuning of metasurface properties is essential for maximizing its coupling with transmitting and receiving radiofrequency (RF) coils of a magnetic resonance imaging (MRI) system. We have studied numerically and experimentally two designs of metasurfaces with different tunability mechanisms. The first design is a hybrid structure based on periodic wires with extremities penetrating high-permittivity dielectric volumes, where tunability achieved by changing properties of the dielectric parts. The second metasurface is formed by an array of capacitively loaded telescopic wires that permit to adjust the eigenmode resonance frequencies by mechanical expansion of the wires. Both metasurfaces demonstrated the spectacular capability to locally enhance the magnetic field of an external RF coil being precisely tuned to the Larmor frequency of a clinical MRI scanner.

The Seminar will be held on Monday,  
October 29, 2018, at 13:00,  
Room 011, Classroom Building, Faculty of Engineering,  
Tel-Aviv University, Ramat-Aviv

הסמינר יתקיים ביום שני,  
29 באוקטובר 2018, בשעה 13:00,  
בחדר 011, בניין כיתות חשמל,  
אוניברסיטת תל-אביב, רמת-אביב

כיבוד קל יוגש לפני ההרצאה | Light refreshments will be served before the lecture